Cottage Lake
Total Phosphorus
Total Maximum Daily Load

Water Quality Implementation Plan

DRAFT

November 2006
Publication Number 06-10-066


Printed on Recycled Paper

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November 2006
Publication Number 06-10-066

This document can be viewed or downloaded from the internet at the following site:
http://www.ecy.wa.gov/programs/wq/tmdl/watershed/index.html.

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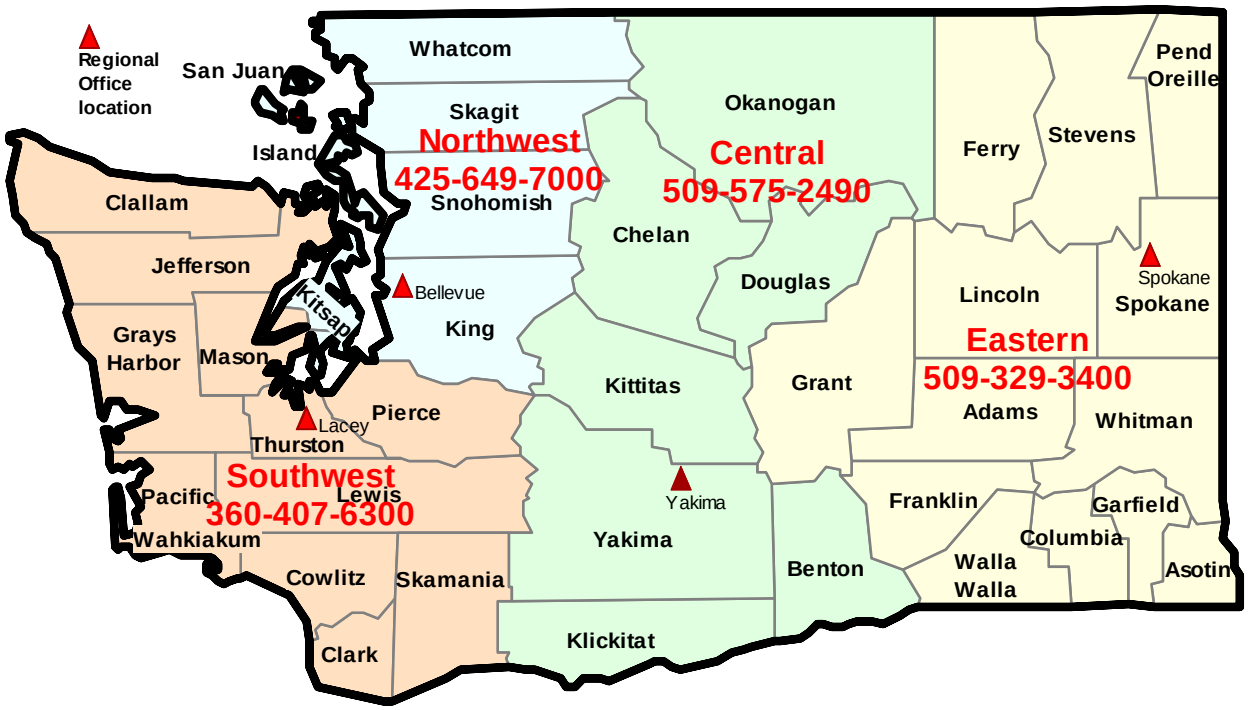

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Executive Summary

For the past several decades, Cottage Lake has experienced elevated levels of total phosphorus which has led to increased occurrences of algal blooms through out the lake. Beneficial uses such as swimming, fishing, boating, and wildlife viewing have been significantly affected.

Due to continuing impacts on beneficial uses, a **Total Maximum Daily Load (TMDL)**[1] for Cottage Lake formally titled the *Cottage Lake Total Phosphorus TMDL Analysis Submittal Report* was developed by The Department of Ecology and approved by the Environmental Protection Agency (EPA) in 2004 to address phosphorus pollution sources in Cottage Lake and its surrounding watershed.

A TMDL is a numerical description of the amount of a pollutant that a water body can accept to ensure that State Water Quality Standards (Washington Administrative Code 173-201A) will be achieved. The *Cottage Lake Total Phosphorus TMDL Analysis Submittal Report* set the total phosphorus target concentration for Cottage Lake at twenty (20) micrograms per liter (ug/L) for the summer months of June through August (Whiley 2004).

Now this document, the *Cottage Lake Phosphorus Water Quality Implementation Plan* is the follow up document to the *Cottage Lake Total Phosphorus TMDL Analysis/Submittal Report* and provides a framework for corrective actions to address sources of phosphorus pollution in the Cottage Lake Watershed.

The *Cottage Lake Phosphorus Water Quality Implementation Plan* is based on: 1) the findings of the *Cottage Lake Total Phosphorus TMDL Load Analysis Submittal Report*, 2) the 1996 *Cottage Lake Management Plan* and, 3) meetings with local government agencies and watershed residents. It provides a strategy for reducing phosphorus levels in Cottage Lake and in the surrounding Bear Creek Watershed and outlines activities that should reduce phosphorus levels in Cottage Lake.

During the preparation of the *Cottage Lake Phosphorus Water Quality Implementation Plan*, a direct stormwater discharge to Cottage Lake was discovered. For that reason, Ecology has decided to redistribute the available phosphorus loading capacity for the lake to allow a wasteload allocation (**WLA**) for stormwater. Appendix C in this document describes the rationale and procedure for redistributing a portion of the load allocation to the category of wasteload allocation, thus allowing for the legal discharge of phosphorus in stormwater from a previously unknown source.

The *Cottage Lake Phosphorus Water Quality Implementation Plan* provides a timeline for when recommended projects will be completed, lists local government agencies and other entities that plan to implement projects, and provides various funding opportunities.

[1] Definitions for bold text can be found in Appendix A.

Introduction

The Washington State Department of Ecology (Ecology) is concerned about the quality of water in Cottage Lake (Figure 1). Cottage Lake is polluted with high levels of phosphorus. This is a problem because the high levels of phosphorus can promote algae growth that reduces the clarity of lake water and make the lake less desirable for swimming, boating, and other recreational activities.

Cottage Lake became polluted because of the way certain activities are performed, not the activities themselves. For example, fertilizing lawns and washing automobiles are not necessarily problems; however, allowing fertilizers and soapy water to reach Cottage Lake and its tributaries is a problem. The solution is to perform these everyday activities in a manner that allows residents to have both a modern lifestyle and clean water.

To improve and protect the waters of Cottage Lake, Ecology prepared this report, the *Cottage Lake Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* (referred to hereafter as the *Water Quality Implementation Plan*). It details the current understanding of the phosphorus pollution problem in the Cottage Lake watershed and the actions that should be taken to solve it. However this *Water Quality Implementation Plan* will not be effective and Cottage Lake will not improve unless it is put into action.

Section **303(d)** of the Federal **Clean Water Act** (CWA) requires a scientific explanation when local waters are found to exceed water quality standards. This scientific explanation is called a Total Maximum Daily Load Assessment or "**TMDL**." In Washington State, the Department of Ecology prepares a Water Quality Improvement Plan that contains the TMDL. Ecology then sends the plan to the United States Environmental Protection Agency (EPA) for review and approval. You can learn more about the federal TMDL program at: http://www.epa.gov/owow/tmdl/intro.html.

In this *Water Quality Implementation Plan*, information about the sources of phosphorus, and recommendations on how to get this pollutant under control will be discussed. This plan will also provide specific information about the Cottage Lake watershed, and how everyday activities might be affecting Cottage Lake and its tributaries.

Finally, this *Water Quality Implementation Plan* will describe activities of your local city and county government, environmental organizations, and what residents in the area can do to be part of the solution.

In the following pages, we will discuss:

- How does the Water Cleanup Process work and why does Cottage Lake need help?
- Where is the Cottage Lake Watershed and where is the pollution coming from?
- How will phosphorus pollution be addressed in the Cottage Lake watershed?

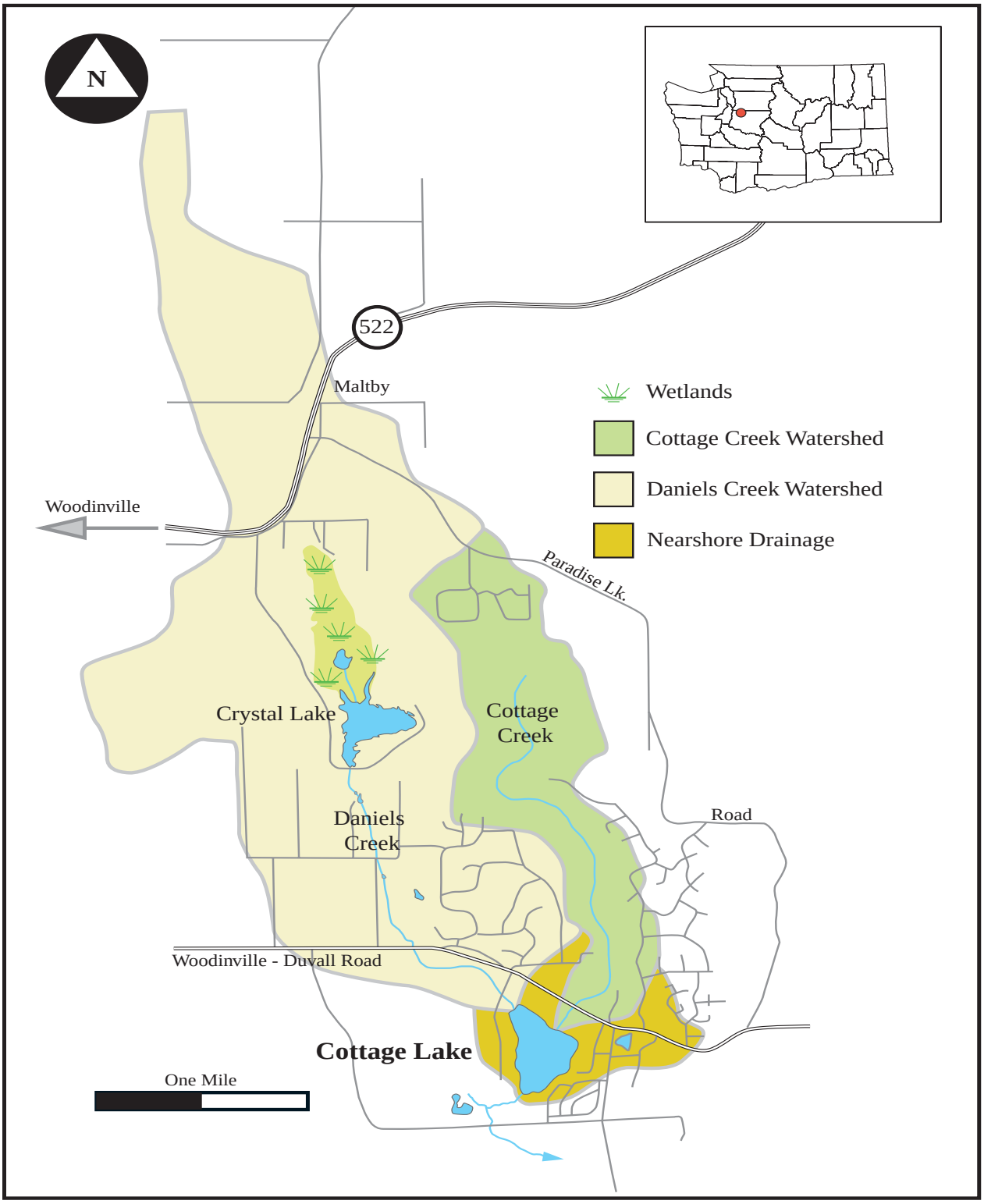

Figure 1. Cottage Lake Watershed. The Cottage Lake Watershed has two main inlet tributaries, Daniels Creek and Cottage Lake Creek. The Daniels Creek drainage encompasses approximately 70 percent (3,100 acres) of the total watershed, while the Cottage Lake Creek drainage encompasses approximately 23 percent (1,000 acres) of the watershed.

The Clean up Process

Lakes that are polluted such as Cottage Lake are subject to Washington State Department of Ecology's three-step TMDL process (see Figure 2). Cottage Lake is in **Step 3** of the process.

Step 1: Ecology reviews **Phase I** and **Phase II Lake Restoration Plans**, and then converts them into a TMDL. Cottage Lake Management Plan (Phase 1 Restoration Plan) was prepared by King County Surface Water Management and KCM, Inc., and completed in 1996. The Management Plan identifies sources of phosphorus pollution, and provides recommendations to reduce pollutant sources for the lake and its surrounding watershed.

Step 2: Ecology meets with local agencies and community stakeholders and develops a lake TMDL. Information from the Cottage Lake Management Plan formed the basis of the *Cottage Lake Total Phosphorus Total Maximum Daily Load Analysis Submittal Report*. The Cottage Lake TMDL was completed and approved in March 2004.

Step 3: A committee consisting of local government, businesses, and homeowners come together to develop a *Water Quality Implementation Plan*. The plan describes specific projects that will be carried out in Cottage Lake and its watershed in order to make the lake recreationally-safe for people and fish. The *Cottage Lake Phosphorus Water Quality Implementation Plan* is described in this document.

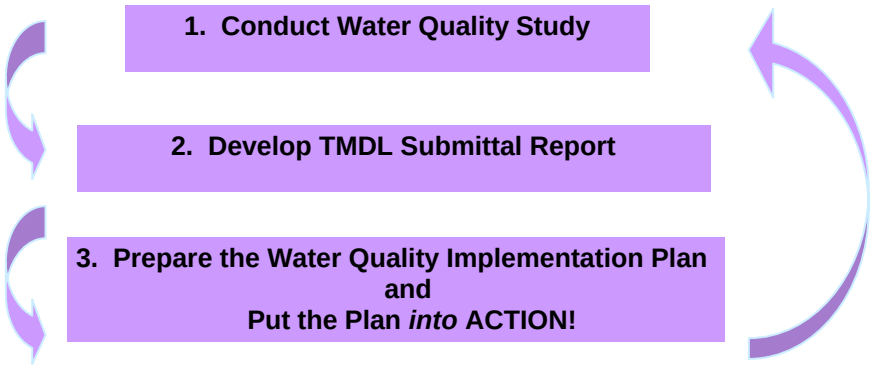

Figure 2. Ecology's process for developing TMDLs and Water Quality Implementation Plans.

Problem Statement

Water quality data collected since the 1970's have characterized Cottage Lake as a nutrient-rich, biologically productive system. Unfortunately, nutrient-rich lakes are frequently plagued with seasonal algal blooms due to elevated levels of total phosphorus in the spring and summer. Coupled with low transparency, this condition has led to a degradation of Cottage Lake's characteristic uses. Swimming, fishing, boating, wildlife habitat, and aesthetic enjoyment have all been significantly hindered. Infestations of non-native noxious weeds, which include purple loosestrife, fragrant white water lily, yellow flag Iris, and curly leaf pondweed, also continue to be a concern (King County, 1996).

Why is phosphorus a problem?

Phosphorus, a basic element found in nature, is also a primary nutrient that all living organisms need to survive. Lakes can build up phosphorus levels as they fill with sediment over time, a process that usually takes thousands of years. This process is called **eutrophication**. Increased amounts of phosphorus can be detrimental to a lake's water quality and its beneficial uses (Figure 3). High levels of phosphorus can cause excessive plant and algae growth, which in turn may have unfavorable impacts to water clarity, aquatic habitat, fish survival, swimming, boating and aesthetic enjoyment (Murphy et al., 2002). Human activities such as home building, road construction, and deforestation can drastically speed up a lake's aging process.

For lakes in the northern temperate zone of the United States; such as Cottage Lake, phosphorus is usually the main nutrient that drives the eutrophication process. Though other nutrients such as potassium and nitrogen can also affect surface water quality, it is the amount of phosphorus being transported through various pathways in the watershed that limits the amount of algal growth and aquatic plants (Minnesota Department of Agriculture 2004). Nutrient levels generally determine a lake's level of biological activity or "**trophic state**."

Lakes with low levels of biological activity are called "**oligotrophic**." Those with moderate biological activity are "**mesotrophic**." When lakes have high levels of nutrients, and biological activity, they are considered "**eutrophic**." Lakes with lower biological activity generally have better water clarity and are more desirable for swimming and boating activities.

Washington State water quality criteria for phosphorus

In Washington State, a water body is considered polluted when it exceeds the thresholds set forth in the Washington State Water Quality Standards (WAC 173-201A). However, unlike most pollutant parameters, the Water Quality Standards do not have specific numeric criteria for total phosphorus; instead lake phosphorus capacity needs to be determined for each lake. Therefore, a **load capacity** or the maximum amount of total phosphorus that can be introduced to Cottage Lake must be established. A **target concentration** is developed to achieve necessary reductions of total phosphorus loading. The term target concentration, relates to the specific numeric amount of total phosphorus resulting from modeling calculations.

Ecology bases its criterion of total phosphorus target concentrations on an eco-regional basis. Eco-regions are divided into Pacific Coast range, Puget Sound Lowlands, and Northern Rockies. Cottage Lake lies within the Puget Sound Lowlands eco-region. More information concerning the Washington State water quality criteria for phosphorus can be found in Appendix B.

Cottage Lake's inclusion on the state 303 (d) list.

Although the State of Washington does not have specified numeric criteria for phosphorus, the amount of total phosphorus entering a water body is used to determine a lake's trophic state. Cottage Lake was on the 1996, 1998, and 2002/2004 **State 303(d) lists** for having high levels of total phosphorus. For this reason, the Cottage Lake Phosphorus TMDL was prepared.

Figure 3. Plant growth in Western Washington Lakes. Excessive plant growth seen here in Cottage Lake may be a result of bottom sediments that are nutrient-rich with excessive amounts of phosphorus.

Summary of the Cottage Lake Phosphorus TMDL Submittal Report /TMDL Amendment

In 2003, Ecology developed a TMDL to address the total phosphorus listing in Cottage Lake. Ecology used data collected from the 1996 *Cottage Lake Management Plan*, as well as data collected in recent years by King County's Department of Natural Resources Lake Stewardship Program. The data was sufficient to establish Cottage Lake's Total Phosphorus **loading capacity** as well as establish of a total phosphorus target concentration for the lake. Ecology set **load allocations (LAs)** on a geographic basis and the Cottage Lake TMDL was approved by the United States Environmental Protection Agency (EPA) in March of 2004.

Based upon new information discovered during the development of this plan, the Cottage Lake TMDL is being amended as part of this plan. The findings of the Cottage Lake TMDL and the amendment are discussed below.

TMDL distribution of phosphorus inputs into Cottage Lake

The Cottage Lake TMDL determined that 1993 phosphorus levels in the **epilimnion** (upper level of the lake) were approximately twice as high as they should be during the months June through August. In order for Cottage Lake to remain at or below water quality standards for total phosphorus, a target concentration of twenty (20) micrograms per liter (ug/L) must be achieved. The summer season is of particular importance due to the congruent relationship of high recreational use and increased algal growth (Whiley 2004).

The Cottage Lake TMDL indicated that all contributing sources of phosphorus need to be reduced. The modeling analysis concluded that a fifty (50) percent reduction in total phosphorus loading (internal and external) is necessary to achieve a summer mean concentration of 20 ug/L. A margin of safety of ten (10) percent beyond that level was also established in the TMDL

Ecology also examined the effect of future development in the watershed by modeling hypothetical lake phosphorus levels assuming the watershed was fully developed to current zoning designations for both King and Snohomish counties. Without controls, the amount of phosphorus within the upper water column during June through August was projected to be approximately forty-two (42) micrograms per liter. To meet the load capacity set for external sources, the future estimated conditions external loading of phosphorus needs to be reduced by sixty (60) percent.

The Cottage Lake TMDL concluded that pipes discharging directly into the lake would be considered point sources of pollution and would require a WLA. The Cottage Lake TMDL determined that there were no known direct discharges to the Cottage Lake. Therefore, the WLA was set at zero.

However, during the development of this plan, Ecology and King County discovered a stormwater outfall at 188 Place NE that needs a WLA. Using the same loading model assumptions used in the *Cottage Lake Total Phosphorus TMDL Analysis/Submittal Report*., Ecology is amending the TMDL by adding a stormwater WLA for the new outfall. For a complete description of the redistribution of a portion of the LA to the category of WLA, please refer to Appendix C of this document.

The TMDL now distributes most of the phosphorus loading capacity (LC) to various load allocation (LA) categories with a small portion redistributed to the WLA category to address the 188 PL NE outfall (Table 1). Figure 1 shows the subbasin boundaries for the Daniel's Creek and Cottage Lake Creek sub basins, and the area from which near shore surface water runoff occurs. Discharges into the creeks and streams of these sub basins were not considered point sources.

Table 1. Phosphorus load allocations for Cottage Lake. The phosphorus loading capacity for Cottage Lake was distributed to nonpoint source pollution and is measured during the months June through August.

Total Phosphorus Source	Loading Capacity Distribution (kg/June-August)	
	Original TMDL	Amended TMDL
Daniel's Creek subbasin	16	16
Cottage Lake Creek subbasin	4	4
Nearshore surface water runoff	1	0.98
Nearshore groundwater inflow	3	3
Internal recycling	15	15
Wasteload Allocation (King County MS4)	0	0.02
Margin of Safety	4	4
Total	**43**	**43**

Establishing the Loading Capacity

1) **Wasteload Allocation (WLA)**: This represents the contribution of discrete "point" sources of pollutants (e.g., municipal, industrial, and construction stormwater discharges);

2) **Load Allocation (LA)**: This represents "nonpoint" sources of a pollutant, (natural sources, most agricultural activities, and other sources that are not regulated by an Ecology permit); and

3) **Margin of Safety (MOS):** This allows for uncertainty in the estimation of, and ability to achieve, the previous two allocations.

Thus, the TMDL equation is as follows:

TMDL = WLA + LA + MOS.

The sum of these three components is also called the **Loading Capacity**.

Figure 4. Doing the math: How does a TMDL add up? These three parts of a TMDL add up to the maximum amount of a pollutant that a water body can receive before it is considered polluted.

What is the current quality of water in the Cottage Lake Watershed?

In 1996, King County Surface Water Management was awarded a Centennial Clean Water Fund (CCWF) grant by Ecology to develop the Cottage Lake Management Plan. As part of the grant, King County's Lake Stewardship Program (KCLSP) sampled both the lake and its inlet streams, Daniels Creek and Cottage Lake Creek. Since the completion of the plan, King County's Lake Stewardship volunteer monitoring program has continued to monitor lake water quality on a periodic basis.

Recent water quality data shows total phosphorus levels have steadily decreased since the early 1990's. Fecal coliform levels however, have increased in both Daniels and Cottage Lake Creeks (KCLSP Centennial Grant Application 2005). Fecal coliform levels with in Cottage Lake and its tributaries have been noted as a public health concern, but not enough data have been collected to list Cottage Lake for fecal coliform on the State 303(d) list.

The Cottage Lake Management Plan identifies sources of water quality impairments with in the Cottage Lake Watershed and makes recommendations to reduce total phosphorus input to the lake. Specifically, the plan outlines fourteen (14) recommendations to address specific internal and external sources of pollution that contribute to phosphorus loading of Cottage Lake. To date, many of the recommendations have not been implemented due to a lack of funding.

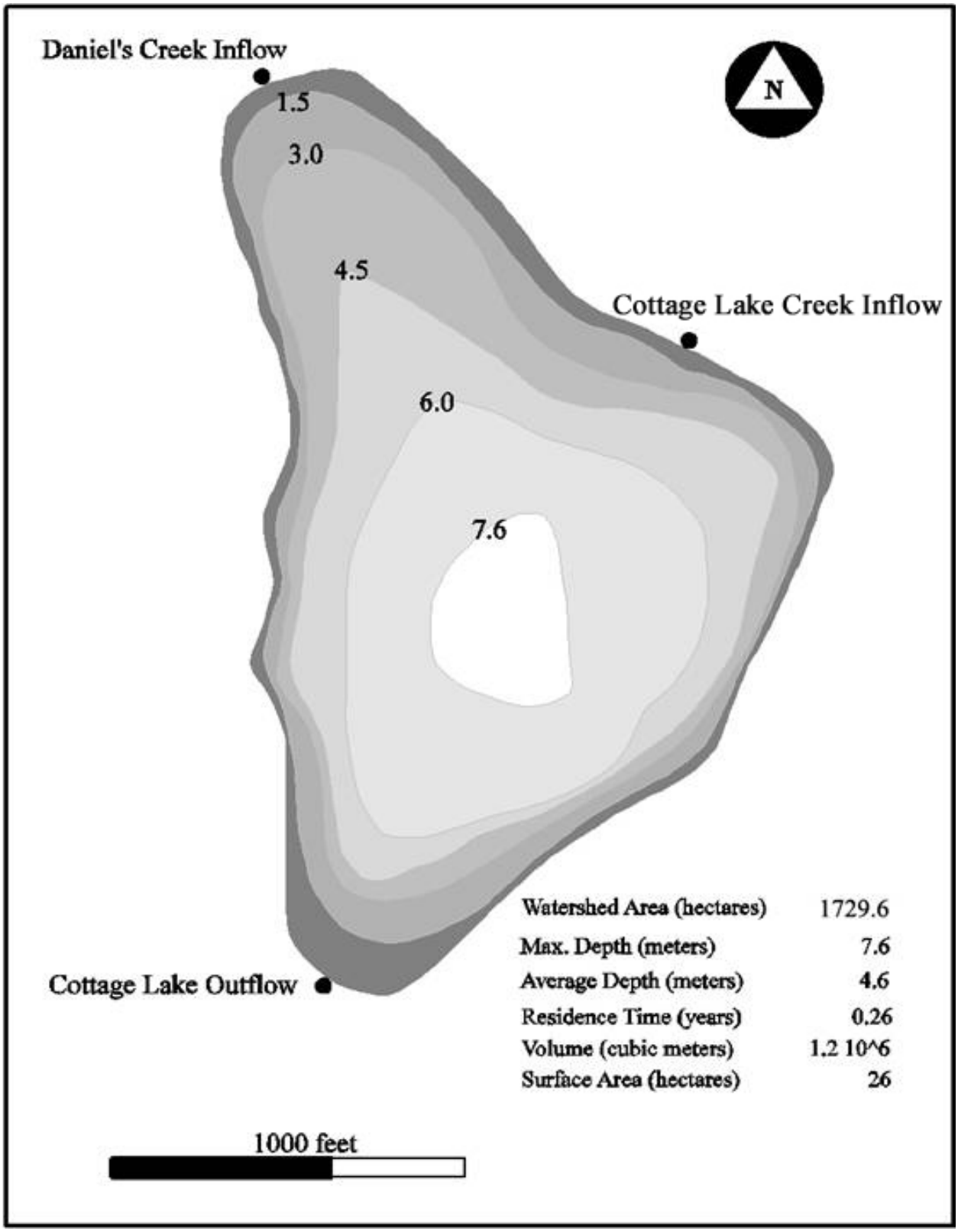

Figure 5. Bathymetry of Cottage Lake (depth contours in meters). Cottage Lake is approximately 7.6 meters (25 feet) at its deepest point.

Description of the Cottage Lake Watershed

Located in Watershed Resource Inventory Area (WRIA) 8 in unincorporated King County, Cottage Lake is approximately 1.5 miles east of the city of Woodinville (Figure 1). Cottage Lake is 63 acres in size with a maximum depth of 7.6 meters (approximately 25 feet), and considered a primary recreational resource for the area (Figure 5). The Cottage Lake watershed encompasses 4,275 acres of the upper Bear Creek Basin and is located in northeast King County, and south Snohomish County. In the mid-1990's, King County purchased a twenty (20) acre parcel along the northern shoreline of the lake, formerly known as Norm's Resort, and converted the property into Cottage Lake Park (King County et al., 1996). The relatively new park allows the general public access to the lake and the opportunity to swim, boat, and fish.

There are two primary inlet streams to Cottage Lake: Daniels Creek and Cottage Lake Creek. Daniels Creek encompasses approximately 3,100 acres, which is nearly 70 percent of the Cottage Lake Watershed. Little Lake (located just above Crystal Lake) and its surrounding wetland area form the headwaters of Daniels Creek. Daniels Creek is also noted for it is significance as a salmonid spawning and rearing stream for Coho and Cutthroat Trout. (Cold Creek Site Management Plan, 2001.)

Cottage Lake Creek encompasses approximately 1000 acres which is nearly 23 percent of the Cottage Lake Watershed. Cottage Lake Creek is noted for having a large run of wild Chinook salmon. Fish populations exist above and below Cottage Lake; however increasing urbanization is compromising the complexity of the Creek's riparian and spawning areas. (Cold Creek Site Management Plan, 2001.)

Cottage Lake is classified as a nutrient-rich, biologically productive, eutrophic lake. Within the past few decades, Cottage Lake has experienced increased algal blooms, increased aquatic plant growth of both native and non-native plants, and a significant decrease in water clarity. In the 1996 *Cottage Lake Management Plan*, intensive studies show that over fifty-one percent (51%) of total phosphorus was entering the lake from Daniels Creek, twenty-nine percent (29%) from internal recycling, eleven percent (11%) from Cottage Lake Creek, five percent (5%) from groundwater, two percent (2%) from nearshore areas, and two percent (2 %) precipitation (King County et al.1996).

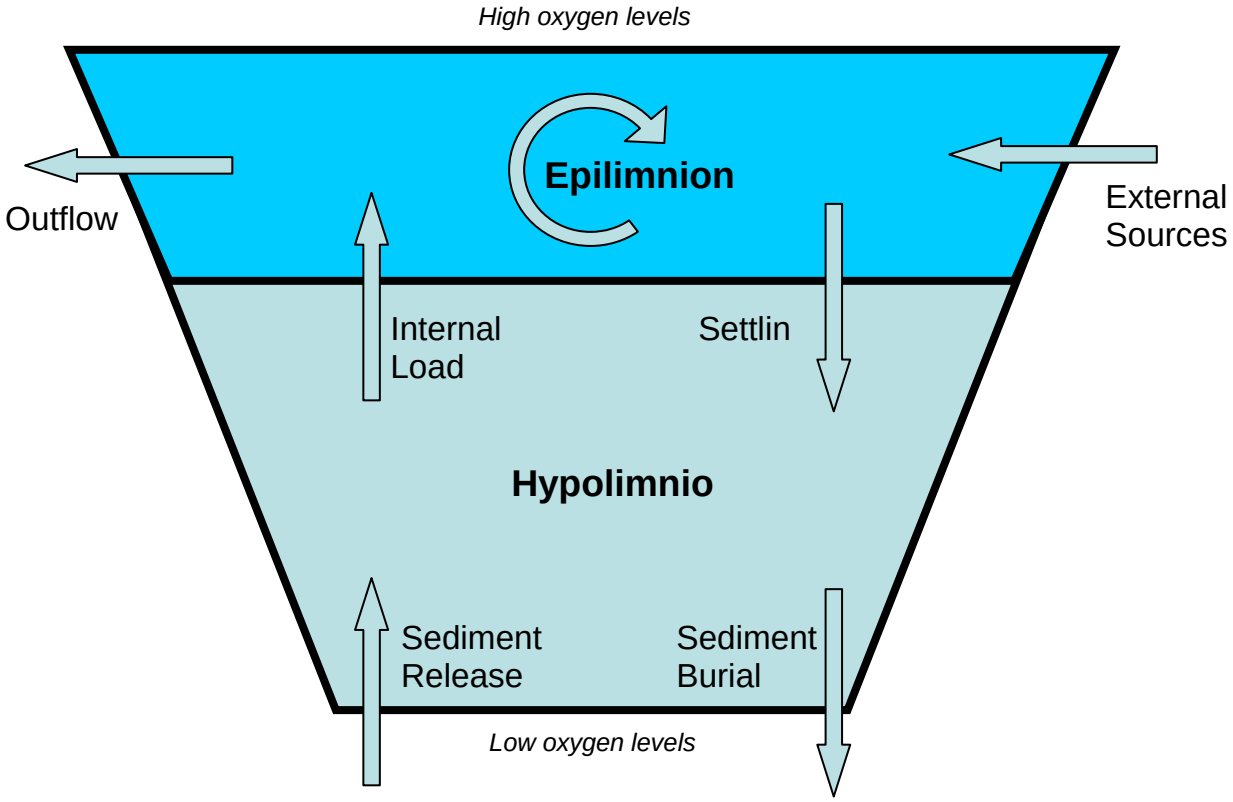

Figure 6. Phosphorus dynamics in Cottage Lake. Phosphorus is constantly entering and exiting the water column in Cottage Lake. The amount of phosphorus available to algae in the epilimnion is dependant on the level of external sources, the amount leaving the lake, and mixing with the hypolimnion.

Water pollution sources and pathways

Lakes like Cottage Lake need a certain amount of phosphorus to remain in good health since it is a nutrient necessary for life. Too much phosphorus however, can stimulate algae blooms that are considered nuisances and discourage beneficial uses of the lake.

Cottage Lake is influenced by two distinct types of phosphorus loading that occur during certain times in the year: **internal loading** and **external loading** (Figure 6). *Internal* loading occurs when phosphorus builds up in lake sediments and is released into the deepest parts of the water column. When sufficient water circulation or "turnover" of the lake waters stimulates the upper part of the lake and can lead to algal blooms. This phenomenon is particularly common in the summer and fall months when it can cause frequent algae blooms and excessive plant growth in Cottage Lake (King County et al., 1996 pp. 6-5, 6-6).

External loading is the introduction of total phosphorus from all other sources within the watershed. Some of the external loading mixes with lake waters and is immediately available to support algal growth. A portion of it flushes through. The remainder of the particulate phosphorus settles to the bottom of Cottage Lake. Some of it settles quickly, the remainder is used by plants and other organisms and settles to the lake bottom as they die. When this settling action happens, external loading can contribute to internal loading. External loading must be controlled to prevent internal loading from increasing.

The *Cottage Lake Total Phosphorus Total Maximum Daily Load Analysis Submittal Report* determined that there are six primary pathways for total phosphorus to enter Cottage Lake. These pathways are listed in order of how much pollution they contribute to Cottage Lake.

- Daniels Creek (51%)
- Internal recycling (loading) of phosphorus. (29%)
- Cottage Lake Creek (11%)
- Groundwater inflow (5%)
- Nearshore surface runoff (yards, driveways, and roads) (2%)
- Precipitation (2%)

Most of the loading is coming from external sources including Daniels Creek and Cottage Lake Creek. Therefore, it is important to control phosphorus inputs throughout the Cottage Lake watershed. The major sources of phosphorus pollution sources are discussed below.

Stormwater

In a watershed that is covered with natural vegetation and trees, water from rainfall or snow melt is easily absorbed into the ground. Where natural vegetation has been altered, more water flows off the land to local streams. This water is commonly referred to as **stormwater** (Figure 7). In shoreline and rural areas, lawns and animal pastures are good examples of where stormwater

may be generated. In more developed areas, stormwater is generated primarily by road surfaces, roof tops, driveways and other impervious surfaces (municipal stormwater), or by building activities (Construction Stormwater General Permit 2006).

As stormwater moves through the watershed, it picks up all types of pollutant sources, which include sediment, fertilizers, pet and wildlife waste, pesticides, vehicle fluids, and household product waste. The amount of naturally vegetated area loss due to development is directly correlated with the amount of stormwater present in a watershed (Phase 1 Municipal Stormwater permit 2006).

As *sub-urban* areas continue to grow throughout the state, the amount of impervious surface increases and stormwater impacts become more prevalent. Stormwater is the most significant source of pollution affecting Washington State waterways. It can carry bacteria from pet waste, runoff from failing onsite septic systems (OSSs), sediment runoff, excess nutrients from lawns and gardens, and pollutants associated with activities such as construction and road building. The transport of pollutants via stormwater may also increase lake eutrophication, sedimentation, reduce water clarity, swim beach and shellfish closures, and contaminate water wells (Phase 1 Municipal Stormwater NPDES and State Waste Discharge General Permit).

As more natural land is altered by development projects in the Cottage Lake watershed, stormwater becomes more of a concern. To control stormwater and prevent it from further affecting Cottage Lake, **Best Management Practices (BMPs)** should be implemented. BMPs are tools and techniques that help to prevent environmental damage and are developed specifically to address a particular source of pollution. BMPs can consist of physical structures, such as stormwater collection ponds, revegetation projects, education, and outreach to local residents, or street sweeping.

Ecology is the state agency delegated authority to administer NPDES permits to control several types of stormwater. This *Water Quality Implementation Plan* will discuss municipal and construction stormwater pollution sources separately below. Stormwater pollution related to other activities is discussed later in this section.

Federal and state regulations address municipal stormwater through Ecology's Phase I and Phase II Municipal Stormwater Permit programs. The municipal stormwater permit allows permit holders to discharge stormwater to waters of state of Washington through storm sewers that are owned and operated by permit holders. Under section 402 (p)(3) of the Federal Clean Water Act, discharges covered under the Municipal Stormwater Permits must prohibit non-stormwater discharges from entering stormwater systems, and must apply controls to reduce the discharge of pollutants to Maximum Extent Possible (MEP) (Municipal Stormwater *draft* Permits 2006).

Figure 7. Stormwater Pollution. Stormwater can carry a variety of pollutants including: sediment, household products, fertilizers, bacteria, and phosphorus. Some of these pollutants can enter Daniels and Cottage Lake Creeks, and eventually enter Cottage Lake.

Both King and Snohomish Counties have Phase I permits. The basic provisions of these permit programs will contribute to the success of this *Water Quality Implementation Plan* and include the following elements:

1. *Eliminate illicit discharges (such as illegal sanitary sewer connections.*
2. *Analyze, prioritize, and schedule the implementation of stormwater management needs.*
3. *Establish adequate legal authority to control stormwater discharges from its stormwater system.*
4. *Monitor the effectiveness of its stormwater management program.*
5. *Develop watershed-wide coordination mechanisms for shared water bodies.*
6. *Develop a program to control runoff from new development, redevelopment activities, and construction sites discharging to the sewer system.*
7. *Ensure appropriate treatment and source control measure are in place to reduce pollutants from existing commercial and residential areas discharging to the storm sewer.*
8. *Ensure appropriate operation and maintenance of stormwater facilities discharging to the stormwater sewer system,*
9. *Develop an educational program aimed at residents, businesses, industries, and employees whose job functions may affect stormwater quality.*

Table 2. Potential pollution sources. The sources listed below are some of the most common activities associated with contributing pollutants to local water bodies (i.e., Cottage Lake, Daniels and Cottage Lake Creeks) particularly excessive amounts of phosphorus.

Sources	Explanation
Stormwater	Stormwater can transport: Small farm and residential pet waste, illegal connections of sewer to storm drainage system, nutrient runoff from excessive lawn and garden fertilization, sewage from failing onsite septic tanks, car wash wastewater, and stormwater runoff from composting facilities. Removal of shoreline vegetation can also contribute to the amount of untreated stormwater that can enter a water body.
Septic Systems	Mal-functioning septic system could be caused by: improper soil, maintenance, construction, or improper use.
Sediments	Contain high levels of phosphorus.
Commercial Agriculture –Non-permitted	Bacteria, nutrients, and surface runoff from improper grazing or manure management practices; excessive use of fertilizers; removal of riparian vegetation; certain ditch maintenance practices.
Small Farms	Bacteria, nutrients, and surface runoff from improper grazing or manure management practices; removal of riparian vegetation.
Wildlife	Usually considered part of natural background levels. An exception can occur when a pollution source is created by man-made alterations of the environment.
Construction	Improper on-site control of soils and disturbed ground.
Loss of Riparian Habitat	Lack of shoreline vegetation to buffer contaminants. Lack of buffer affects temperature and dissolved oxygen levels and nutrients entering the Lake.

Many of the requirements in the Phase I Municipal Stormwater Permit can contribute to the success of this *Water Quality Implementation Plan*. The permit provides the following specific opportunities where permit holders can target the control of phosphorus inputs from stormwater:

- Condition S5.C.6. Structural Stormwater Control Program.

  The permit requires a program to construct structural stormwater controls to address the impacts to beneficial uses of local waters from existing development. No later than 18 months after the permit is issued, permit holders will complete the development of this program and begin implementation.

- Condition S5.C.7. Source Control Program for Existing Development

  The permit requires a program to reduce pollutants in runoff from areas that discharge to municipal storm sewers. This program requires inspections and enforcement of ordinances to control, at a minimum, fertilizers discharges to their storm sewer system.

- Condition S5.C.10. Education and Outreach Program

> Phase I permit holders must have a program to educate residents, businesses, industries, elected officials, internal staff, and others about the behaviors and practices that cause or contribute to adverse stormwater impacts. The program will increase the awareness of targeted audiences to improve water quality by reducing impervious surfaces, using natural yard care techniques, identifying illicit discharges, and other practices that can reduce phosphorus discharges in stormwater.

Ecology expects to re-issue Phase I Municipal Stormwater Permits to Snohomish and King Counties in late 2006. (For up-to-date information on the permit see Ecology's webpage at (http://www.ecy.wa.gov/programs/wq/stormwater/municipal/issue_permits.html.)

Corrective/preventative actions: Ecology has determined that many actions already required in the Phase I municipal stormwater permit will help control phosphorus discharges into the Cottage Lake Watershed. To address phosphorus pollution from stormwater, this *Water Quality Implementation Plan* strongly recommends that the following BMPs and activities be used by municipal stormwater permit holders to control current and future phosphorus discharges to the Cottage Lake Watershed:

- Require the use of techniques outlined in the Low Impact Development Technical Manual for Puget Sound, January 2005, for all new development and redevelopment.
- Require use of Ecology's Phosphorus Treatment Menu (or equivalent) as established in Volume V, section 3.3 of Ecology's Western Washington Stormwater Manual for all new development, redevelopment, or stormwater pond retrofits.
- Strongly consider stormwater treatment retrofits in any areas where high phosphorus inputs are detected that cannot be reduced or eliminated using source control best management practices. Soil augmentation retrofits should be considered where this technique could significantly reduce stormwater runoff volumes.
- Require that all new high density residential complexes include car washing facilities to help prevent future discharges of phosphorus to the **MS4**.
- Increase the awareness of phosphorus pollution problems in the Cottage Lake Watershed (currently Special Condition S5.C.10 (b)(ii) in the draft Phase I Municipal Stormwater Permit.)
- Consider prioritizing Outfall Reconnaissance Inventories (ORIs) in the area of this TMDL. All ORIs should include screening for sewage/septic sources and surfactants/soaps in the Cottage Lake Watershed.
- Include the discussion of phosphorus pollution control as part of required coordination activities for physically connected and shared MS4s (currently in S5.C.3 of the draft Phase I permit.)
- Prepare a Phosphorus Pollution Remediation Plan as part of the Stormwater Management Plan (SWMP). The purpose of the plan would be to 1) inform the public of all activities underway or planned to reduce phosphorus inputs from the municipal separate storm sewer system (MS4) and 2) provide a focal point for public comment on this known pollution problem. Relevant activities to discuss include the use of applicable

ordinances, inspection and enforcement capabilities, illicit discharge program elements, and water quality monitoring.

Ecology will also be requesting that Phase I permit holder King County report on the current level of phosphorus removal provided by its stormwater management system for the 188th PL NE outfall. If additional treatment is needed to comply with this TMDL, Ecology will develop a compliance schedule or require implementation of additional best management practices.

Ecology recognizes that there are both practical and technical limitations for phosphorus removal in retrofit situations. For that reason, Ecology encourages Municipalities to explore cost-effective phosphorus-reduction solutions that could be used throughout the watershed as part of future water cleanup efforts.

Private Stormwater System Operators

Private stormwater systems are subject to the same pollution sources as publicly owned systems and should evaluate the best management practices above to control phosphorus discharged from the areas covered by their storm sewer systems.

Corrective/preventative actions: Operators of private stormwater systems are encouraged to review the first four recommendations for municipal stormwater permit holders above and work with business owners, residents, and others within your service area to educate them on how to prevent or minimize phosphorus discharges to the storm sewer system.

Construction Stormwater

Ecology requires that a permit be obtained for all soil disturbing activities (including grading, stump removal, demolition) where one (1) or more acres will be disturbed and stormwater will be discharged to a receiving water directly (e.g., wetlands, creeks, unnamed creeks, rivers, marine waters, ditches, estuaries), or to storm drains that discharge to a receiving water. If all stormwater is retained on-site and cannot enter surface waters of the State under any condition, permit coverage is not required. Construction site operators must apply for a permit 60 days prior to discharging stormwater." (Ecology Construction Stormwater Permit 2005.)

Corrective/preventative actions: Because sediments can be a significant source of phosphorus pollution, this implementation plan strongly recommends that the following additional BMPs be used at all construction sites that could discharge stormwater within the Cottage Lake watershed. This plan recommends that Ecology, King County, and Snohomish County provide internal staff training to increase awareness of the phosphorus reduction goals of this TMDL and promote voluntary implementation of the following BMPs through education during permit review meetings and onsite inspections:

- Schedule grading and clearing activities to avoid, or minimize, the possibility of generating stormwater during construction activities.
- Infiltrate construction stormwater.
- Weekly monitoring of stormwater discharges during discharge periods to ensure phosphorus removal techniques are effective.

- Cover all exposed soils.
- Maximize track-out control using aggressive street sweeping and/or wheel wash facilities.
- Restrict/prohibit the use of nonorganic fertilizers or use nonorganic fertilizers that do not contain phosphorous.

Onsite septic systems

Onsite septic systems (OSS), both community-based and individual systems, are not a problem when designed, sited, and operated properly (Figure 8). A properly functioning OSS uses the soil surrounding the drainfield to remove bacteria and some nutrients from the wastewater. However, soil compaction, clogging of the soil with solids, and hydraulic overload can all cause a failure of the system to adequately treat wastewater. Signs of OSS failure include:

Figure 8. On site septic systems. Septic systems require servicing. If you have a septic system and the ground above it is wet, squishy, or smells bad, you should have it inspected and pumped as shown here.

- Odors, surfacing sewage, wet spots, or lush vegetation in the drainfield area.
- Plumbing or septic tank backups.
- Slow draining fixtures.
- Gurgling sound in the plumbing system.

If wastewater surfaces as described in the first bullet above, it is possible that this wastewater could go directly to a nearby stream or ditch and contribute phosphorus to Cottage Lake.

Connecting septic systems to stormwater sewers or piping them directly to surface waters is occasionally discovered and is illegal. Another problem observed in some older septic systems is the subsurface movement of wastewater through extremely porous soils.

House bill 2322 restricting the amount of phosphorus in dishwashing detergent has recently been passed into law. The law is meant to compliment the 1993 law banning of phosphates in laundry detergent, which prohibits the distribution of any dishwashing detergent that contains more than 0.5 percent of phosphorus by weight. Washington State is the first state in the Union to restrict the amount of phosphorus for dishwashing detergent. The law will be effective state-wide by 2010 and may provide some benefit in reducing phosphorus in Cottage Lake.

Corrective/preventative actions: Snohomish County homeowners should contact the Snohomish County Health District for assistance if they suspect a problem with their septic tank. Homeowners should have their septic systems pumped and inspected on a regular basis.

Information on the location and operation of your septic system is available online at http://www.snohd.org/envhealth/www.waste.html or by calling 425-339-5250.

To assist the owners of the 100,000 King County households with onsite septic systems, Public Health's new Operation and Maintenance (O&M) Program offers tips to improve the length of their systems' life and protect the community's health. For more information about the King County Wastewater Program go to: http://www.metrokc.gov/health/wastewater/ or call 206-296-4932.

Sediment

Sediment is a primary source of phosphorus. As sediment is transported through the Cottage Lake Watershed, it will eventually make its way into Cottage Lake. The amount of sediment received by Cottage Lake has a direct effect on its trophic status. Although lakes naturally fill in over time, the process can be dramatically increased by human activities, such as construction, agricultural practices, land development, and the removal of natural vegetation.

Corrective/preventative actions: The activities of King County's Department of Development and Environmental Services (DDES), Snohomish County's Planning and Development Services, and Ecology's general construction permit are expected to control the majority of sediment pollution in the Cottage Lake watershed—these activities are discussed under the Stormwater part of this chapter.

For smaller projects by homeowners near streams or ditches flowing directly to Cottage Lake or one of its tributaries, preventing soil from running off-site is perhaps the most economical and time-saving step. This plan recommends the following best management practices (BMPs), which are proven to be effective in controlling sediment erosion:

1. Protect existing vegetation.
2. Filter fences.
3. Matting.
4. Re-seed exposed areas after disturbing vegetated areas, (i.e., construction, landscaping).

Agriculture and hobby farms

The Cottage Lake watershed has a mix of both commercial horse facilities and hobby farms. (Figure 8). The range of land types used for residential horse facilities is very diverse. For budgetary and other reasons, residential horse owners frequently have limited area for grazing and exercise. Thus, many times horses live in wooded conditions or are confined to small outdoor paddocks where grass and vegetation is quickly consumed or destroyed. Manure deposited by animals frequently finds its way into natural drainage corridors and becomes a source of water pollution.

Corrective/preventative actions: Like commercial facilities, these horse owners need to carefully manage their pastures and the manure produced by their animals. All small farms in the proximity of a drainage conveyance should contact the King or Snohomish Conservation Districts to have a farm plan developed.

Figure 9. Equestrian Facilities. The average horse generates 50 pounds of manure per day (that's 8 tons per year not counting soiled bedding.) This owner uses gravel, rubber mats, wood pellet bedding, interceptor drains, and frequent use of the dumping fork to prevent water pollution and improve compost quality. Composting manure is covered to prevent rain from carrying waste to surface water.

Home and automotive maintenance activities

Many of our everyday activities in and around our homes can have dramatic consequences for our local water bodies. For example, storm drains that remove excess water from streets do not take the water to local a treatment plant as one might believe. More likely, it is ultimately discharging to a local lake or stream. Car wash wastewater going to the nearest water body is a

common problem (Figure10). Whether we are using biodegradable soap, or some other type of soap, the suds that flow off our driveways and down the street often end up in the lake or stream. Most folks wouldn't dream of emptying dirty soapy water into the stream but actually, that is just what happens.

Similarly, if water runs off a fertilized lawn, the same thing can happen. Although you don't have the suds to indicate the pollution, the phosphorus in the fertilizer can be washed away to the storm sewer. Pesticides and herbicides we put on our lawns are also being found in Puget Sound. These compounds act the same way in the water as they do on your lawn. Common garden chemicals damage local waters and are now widespread throughout Puget Sound.

Figure 10. What's wrong with this picture? Although you can't drive your car onto a lake as shown in this picture, if owners are not careful the ultimate destination of car wash wastewater can be Daniels Creek, Cottage Lake Creek, and eventually Cottage Lake.

Corrective/preventative actions: Consider alternatives to concrete or asphalt surfaces. Gravel, wood chips, and various types of porous pavers allow water to filtrate through the ground much faster. These types of surfaces also allow pollutants such as oil, fertilizers and sediment to be contained while water is allowed to seep back into the ground. Ecology encourages a balanced approach between the natural landscape and individual property needs. Here are some other simple steps that homeowners can take to avoid polluting nearby water bodies.

- Reduce or use no chemical fertilizers on your lawn. Excessive use of fertilizers will only "feed" Cottage Lake's nutrient problem, resulting in other problems, such as frequent algal blooms and excessive plant growth.
- Household products (i.e., cleansers, detergents, and auto fluids) used around the house that are improperly disposed of, can also be transported into the lake. Use them sparingly and dispose of them properly.
- Clean up hazardous material spills according to label directions.
- Do not use water to rinse material away. Wipe up spills with an absorbent material. Store all household and automotive products in tightly sealed, leak-proof containers.
- Mulch grass clippings and leaves to naturally fertilize your lawn.
- Maintain native plant vegetation to help stabilize the shoreline and filter pollutants.
- Do not feed wildlife.
- Mulch and plant exposed soil as soon as possible after construction activities. Use sediment barriers when necessary.
- Car washing water, excess fertilizer, pet waste, and anything else that can dissolve in water will travel in stormwater runoff and eventually pollute local water bodies. Instead, wash your car on your lawn or take it to a salmon-friendly car wash.

For more information on household product disposal and alternatives to using such products, see information below.

Contact King County at 206-296-4692 or 1-888-TOXIC-ED or http://www.govlink.org/hazwaste/house/index.cfm.

Contact Snohomish County at 425-388-3411 or 1-800-562-4367 http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SolidWaste/Haz_Waste/household dhazwaste.htm.

King County's Water and Land Resources Division provides several different alternatives to car washing. To get a car wash kit from King County log on to: http://dnr.metrokc.gov/wlr/pi/carwash_res.htm.

Loss of riparian habitat

Riparian zones are defined as the transition zone between land and water environments. This particular area of a lake's ecosystem plays a valuable role in water quality. Riparian zones can be made up of grasses, shrubs, trees, rooted, and submersed aquatic plants. Adequately sized and healthy riparian buffers help filter out a variety of pollutants, stabilize shorelines, reduce flooding, and provide food and shelter for wildlife.

Healthy riparian habitat benefits local waters in many ways such as:

Filtering runoff: Excess water runoff from yards and driveways, which carry sediment and other pollutants are filtered and removed by riparian plants.

Bank stabilization: Native plant buffers extending down to the waters edge can be the most efficient way to stabilize a bank and prevent erosion.

Preservation of Aquatic Habitat: Riparian areas can provide habitat for fish, protection from predators, and provide nesting areas for sensitive species of birds or amphibians.

Aesthetics: Though land owners may have varying opinions of what is aesthetically-pleasing, most agree that viewing wildlife in a somewhat natural setting is important. Leaving a natural riparian area in place could help to provide noise reduction and privacy to homeowners as well (Pennsylvania Association of Conservation Districts).

Corrective/preventative actions: Vegetated buffers should be placed (or left in place) between the lake and shoreline. This plan encourages all affected landowners and developers to maximize buffer widths consistent with reasonable land use expectations and meeting the goal of providing shade and maintaining natural stream and lake landscapes. Lake-side homes should explore natural landscape practices rather than having green, fertilized lawns up to the waters edge. Buffer sizes and plant communities should be designed to filter runoff, stabilize stream banks, and preserve aquatic habitat.

Aquatic weeds

Purple loosestrife, fragrant white water lily, yellow flag Iris, and curly leaf pondweed are invasive, noxious aquatic weeds found in abundance in Cottage Lake (Figure 11). Their excessive growth leads eventually to plant die off and decay in lake sediments and may add an additional source of internal phosphorus loading.

Every effort should be made to eradicate or control these weeds. There are a variety of mechanical, manual, or chemical options available. To learn more about aquatic plant control log on to Ecology's website at **http://www.ecy.wa.gov/programs/wq/links/plants.html.**

Figure 11. Common invasive noxious aquatic weeds in Western Washington. Purple loosestrife photo by B. Blossey, curly leaf pondweed photo by Mark Hartle. Other photo sources unknown.

What will be done and who will do it?

To reach the goal of restoring the water quality of Cottage Lake, this *Water Quality Implementation Plan* outlines specific implementation projects that are either planned or recommended to occur in the Cottage Lake watershed. Prior to this plan, several key implementation strategies have been developed or are currently under development.

1. The *Cottage Lake Management Plan* was finalized in 1996. Many of the activities recommended in that plan were not accomplished due to inadequate funding. Ecology has reviewed the *Cottage Lake Management Plan* and incorporated those activities that have not yet been accomplished and are still relevant.

2. Cottage Lake was designated a ***sensitive lake*** in 1996. Under King County's newly updated Surface Water Design Manual (Core Requirement #8:1.2.8.1B) *Sensitive Lake WQ Treatment Areas* requires: "fifty (50%) percent annual average total phosphorus (TP) removal assuming typical pollutant concentrations in urban runoff."

3. Snohomish County is currently updating its critical areas ordinances to prevent adverse effects of development and redevelopment project areas on fish and wildlife habitat, wetland areas, and flood zones. This affects Snohomish County's southern portion of the upper Bear Creek Basin, including Crystal Lake, headwaters of Daniels Creek.

4. King County Parks and Recreation Division now manages the Cold Creek Natural Area, which comprises 250 acres within the Big Bear Creek Basin. The acquisition of this property is designed to protect and rehabilitate natural ecosystems for fish and wildlife habitat.

Ecology, along with King County Lake Stewardship Program, Friends of Cottage Lake, King Conservation District, Woodinville Water and Sewer District, Snohomish County Surface Water Management, and residents within the Cottage Lake watershed formed an action group titled The Cottage Lake Steering Committee. The committee has met on an occasional basis since March of 2004 developing a strategy to address phosphorus loading in the Cottage Lake Watershed. The recommendations derived from the committee meetings help to form the basis of the Cottage Lake Implementation Plan. The following implementation actions were identified from discussions with the Cottage Lake Steering Committee and other stakeholders in the watershed.

Organizations involved in cleanup efforts

The following organizations and entities are expected to implement phosphorus reduction efforts within the Cottage Lake watershed.

1. Friends of Cottage Lake (FOCL)
2. King Conservation District (KCD)
3. Cottage Lake Steering Committee (CLSC)

4. Woodinville Water and Sewer District (WWSD)
5. Upper Bear Creek Community Council (UBCCC)
6. King County Lake Stewardship Program (KCLSP)
7. Snohomish County (SC)
8. Snohomish Conservation District (SCD)
9. Washington State Department of Ecology (Ecology)

Friends of Cottage Lake

FOCL is a grass-roots non-profit community organization committed to improving and defending the health and continued enjoyment of Cottage Lake. The FOCL consists of residents that live on or near Cottage Lake. FOCL maintains a website and has just begun publishing a newsletter to promote community outreach and education on water quality and other issues. You can learn more about their efforts to protect the water quality of Cottage Lake and its surrounding watershed by visiting http://friendsofcottagelake.org/.

Recommended Actions: Ecology encourages the FOCL to continue its outreach and education activities accomplished by its website and newsletter. FOCL should continue to work directly with KCLSP and continue to participate in the Cottage Lake Steering Committee. Ecology further encourages members of FOCL to actively seek out volunteers to perform rehabilitation projects around the lake and it tributaries, perform volunteer water quality monitoring, and to encourage local residents to implement best management practices (BMPs) on their own properties and within the watershed.

King Conservation District

KCD is a natural resource agency that provides education and technical assistance to landowners, schools and consultants**.** All landowners within the District boundaries are entitled to free information and technical assistance for water quality protection, wildlife habitat enhancement, farm management plans, soil and slope stability information, native plant products, manure exchange information, volunteer opportunities, stream restoration/enhancement assistance and many other natural resource topics http://www.kingcd.org/abo_aboutkcd.htm.

Recommended Actions: KCD should continue to provide guidance and technical assistance to residents with in the watershed. KCD should continue to work with small farms, equestrian facilities, and any landowners that seek support in developing strategies for water quality protection, manure management, farm plan development, and stream rehabilitation.

Cottage Lake Steering Committee

The Cottage Lake Steering Committee consists of The Department of Ecology, King County Lake Stewardship Program, Friends of Cottage Lake, King Conservation District, Woodinville Water and Sewer District, and residents with in the Cottage Lake watershed.

Recommended Actions: CLSC should continue to meet at least once annually to discuss implementation projects that are occurring with in the watershed. The committee is an important entity and should make every effort to stay informed on water quality issues.

Woodinville Water and Sewer District

The Woodinville Water and Sewer District mission is to provide potable water to all customers of the district. Sanitary sewer service is provided to all customers requesting service of the district who are located within the Urban Growth Area (UGA) as established by King County. The Woodinville Water District presently is the fifth largest district in King County, serving approximately 13,300 water customers and 2,500 sewer customers. Future predictions state that there may be 25,000 sewer and water connections by the year 2020.

Woodinville Water District strives to provide safe and reliable service to all our customers at an economical cost, provide potable drinking water to all customers of the district, and to provide sanitary sewer service to all customers requesting service of the district who are located within the Urban Growth Area (UGA) as established by King County. The district educates customers in the efficient use of water and safe disposal of wastewater.

Recommended Actions: This implementation plan encourages the district to continue to support residents within the Upper Bear Creek Basin with education and outreach literature and classes about water quality issues and the implementation of best management practices (BMPs). For more information about Woodinville Water and Sewer Districts Water Education website, visit their website at http://www.woodinvillewater.com/.

Upper Bear Creek Community Council

The purpose of the council is to inform, assist and represent the community in dealing with King County government and other entities with respect to issues that affect the community. The council is recognized by King County as the Unincorporated Area Council serving the Upper Bear Creek area. The council is a volunteer organization with an elected board. Residents are welcome and encouraged to participate (Bear Creek Community Council website 2006).

Recommended Actions: Bear Creek Community Council is encouraged to continue to network with residents in the Upper Bear Creek Watershed to improve the quality of water. The council should continue to represent and support residents with their concerns in dealing with King County government as well as other entities with jurisdiction in the community http://www.upperbearcreek.com/main.asp.

King County Government

King County provides many services that are vital to the successful implementation of this plan. Existing County programs have already recognized the issue of phosphorus pollution in Cottage Lake and other areas of the county. Many of the actions planned by the county are fully funded and others may require grant assistance. Each of these programs is discussed below.

King County Parks and Recreation Division

The county operates Cottage Lake Park, which is located on the north shore of the lake. This Twenty-two (22) acre park provides opportunities for fishing and picnicking and has a car top boat launch. Swimming can be done at the facility's pool but no public beach is provided. The mission of the Parks and Recreation Division is to be a good steward of the region's environment and strengthen sustainable communities by protecting water, land and natural habitats, safely disposing of and reusing wastewater and solid waste, and providing natural areas, parks and recreation programs.

Recommended Actions: This plan recommends that the following actions be implemented at Cottage Lake Park with in the nearshore drainage areas to control phosphorus inputs to Cottage Lake.

- Construct and maintain biofiltration swales at the entrance of the park and near the parking lot to capture phosphorus and other pollutants and prevent it from entering Cottage Lake.
- Rehabilitate shoreline buffers along Cottage Lake and its inlet tributary Cottage Lake Creek to increase filtration of nutrients and sediments, serve as a natural deterrent for waterfowl, increase bank stabilization, and serve as habitat for various species of fish and wildlife.
- Post and maintain educational signage to discourage the feeding of waterfowl and promote good best management practices for citizens and businesses.
- When needed, fertilizer should be used sparingly in accordance with Federal Label rates and be made of organic compounds.
- Install pet waste collection and education stations in several accessible areas around the park.

King County Lake Stewardship Program

The King County Lakes Stewardship Program (KCSLP) is a division of King County Department of Natural Resources and Parks, Water and Land Resources Division. KCSLP documents trends in water quality, encourages citizen stewardship, and provides educational outreach and technical support to lake residents. You can learn more about the KCSLP by visiting their website @ **http://dnr.metrokc.gov/wlr/waterres/smlakes/**.

Recommended Actions: The KCLSP is already begun conducting activities recommended by this Implementation Plan. Working with members of the Friends of Cottage Lake, the KCLSP developed the Cottage Lake Phosphorus Reduction Plan. King County Lake Stewardship Program was awarded an Ecology Centennial Clean Water Fund Grant of $291,728 to assist in funding the activities in Table 3.

As a part of the grant, KCLSP will continue to work with the residents of Friends of Cottage Lake, and other residents with the watershed. Upon completing the requirements of the current grant project, Ecology recommends that KCLSP participate actively in the adaptive management of this TMDL and continue to provide leadership in the development and implementation of future activities to reduce and control phosphorus inputs into Cottage Lake.

Table 3. King County Lake Stewardship Program (KCLSP). The KCLSP is currently implementing a broad based program to improve the health of Cottage Lake. In addition to the actions below, KCLSP is monitoring the water quality of Cottage Lake and its tributaries to find pollution sources and track their progress.

Implementation Strategy	Action	Schedule
Survey	To develop and distribute a survey to residents in the Cottage Lake Watershed. Determine current knowledge, attitude, and behaviors toward phosphorus pollution in Cottage Lake.	January 2006
Education and Outreach	Based on results of survey, KCLSP will work with interested residents to design an educational outreach campaign. Door hangers, brochures, newsletters, and web pages will be used in campaign.	Spring 2006
Workshops	To give hands-on training in Best Management Practices (BMPs), Natural Yard Care, Septic system maintenance.	Spring 2006
Guidebook and Slide Show	Demonstrating how implementation projects for Cottage phosphorus reduction were developed. Education materials, restoration techniques, workshop topics, sampling strategies, and assessment plans will be included in the final product.	To be determined
Native Shoreline Plantings	Based on educational workshops, residents will apply techniques learned, and apply methods to their own landscapes. Attendees of the workshops will be encouraged to promote techniques to their neighbors.	On-going
Public Plantings	KCLSP and King County Parks Department will work together to identify areas in and around Cottage Lake that could be possible restoration project sites.	On-going
Post Survey	At the end of the three year education and outreach portion of KCLSP Centennial Grant, the survey will be re-submitted to watershed residents. To determine if behaviors and attitudes towards phosphorus pollution in Cottage Lake have changed.	On-going

King County Department of Development and Environmental Services

The Department of Development and Environmental Services (DDES) issues building and land use permits for properties located in unincorporated King County. DDES also enforces county land use and building codes and issues business licenses. Clearing and grading permits, and land use permits are both important tools for the protection of Cottage Lake.

As a general rule, a grading permit must be obtained prior to construction for any project meeting one of the criteria below:

- Grading within a sensitive area.
- Excavation greater than five feet in depth or over 100 cubic yards.
- Fill greater than three feet in depth or greater than 100 cubic yards, or
- Creation of more than 2,000 square feet of new impervious surface.

Pre-application meetings are held between a prospective permit applicant and DDES staff before a permit application is filed. The intent of the pre-application meeting is to prepare prospective applicants for the permit process and provide technical guidance to assist customers with the application and review process. Pre-application meetings are mandatory for large or complex building permits (as per 20.20.030* of the King County Code @ www.metrokc.gov/mkcc/code/.)

Typically, this includes any project proposing 5,000 ft^2 (approximately 0.11 acre) or more of building area and/or site development area. Additionally, proposals on a parcel that include critical areas such as wetlands, streams, steep slopes, critical drainage basins, landslide hazards, or erosion hazards require a pre-application meeting. Voluntary pre-application meetings also are offered on smaller projects, should a customer simply want to carefully prepare before submitting an application.

The DDES also implements the requirements in the King County Surface Water Design Manual, which identifies Cottage Lake as a "Sensitive Lake." This designation requires that post-construction stormwater runoff in Sensitive Lake Water Quality Treatment Areas must receive treatment that provides approximately 50 percent phosphorus removal. Ecology anticipates that the requirements in the 2005 King County Surface Water Design Manual will be considered equivalent to the Ecology Phosphorus Treatment menu in the near future. Both of these treatment strategies are important in achieving the reductions called for by this TMDL.

Recommended Actions: This *Water Quality Implementation Plan* strongly recommends that King County continue to require removal of phosphorus as provided in Volume V, Section 3.3 of the 2005 Ecology Western Washington Stormwater Manual. The county should continue to investigate and require new technologies for phosphorus removal as they become available and are both reasonable and achievable to implement. Ecology recommends that the county review and implement all of the recommended actions in the subsection Municipal Stormwater Permits discussed earlier in this plan.

Pre-application meetings held as part of the DDES grading, clearing, and land use permitting processes also provides an excellent opportunity to contribute to the goals of the Cottage Lake TMDL. Ecology recommends that DDES staff discuss the need for controlling phosphorus from construction sites with project proponents and explain the additional actions they can take as outlined under the subsection Construction Stormwater Permits discussed earlier in this plan.

Snohomish County Government

The activities of several branches of Snohomish County Government can affect the overall water quality in the Cottage Lake watershed. The bulk of water quality related activities are carried out by Snohomish County Public Works, which performs a variety of pollution identification and prevention activities. Snohomish County Planning and Development Services are also very important as it oversees building and land development activities and performs enforcement.

Because past land use practices so greatly affect water quality, the activities of this department are especially important to pollution prevention.

Snohomish County Public Works-Surface Water Management
Surface Water Management (SWM) is involved in a wide range of water pollution control activities including education, water quality monitoring, riparian restoration, salmon recovery, native plant salvaging, and NPDES permit administration. SWM conducts education programs for citizens and funds a South County Basin Watershed Steward. Surface Water Management also provides funding for and coordinates with the Snohomish Conservation District. Water quality is tracked through ambient monitoring, targeted pollution source identification, and illicit discharge monitoring.

Snohomish County has several pilot projects underway to explore urban stormwater pollution problems and develop solutions. These include the Animal Waste Control Project, the North Creek Stormwater Management Project, and the Onsite Septic Management Program.

The Animal Waste Control Project focuses on the proper management of pet wastes in urban areas. The North Creek Stormwater Management Project is studying two urban issues: how to maximize Native Growth Protection Areas for removal of pollutants in stormwater and how to perform a low-cost stormwater capture and treatment retrofit in established residential neighborhoods. Finally, the Onsite Septic Management Program involves working with the Snohomish Health District to merge the health district septic system records with Surface Water Management's Geographic Information System (GIS) to identify hot spots and target improvements, conduct sanitary surveys and provide technical assistance to landowners, and provide prevention-based landowner training to ensure proper system operation and maintenance.

The county hopes to take its findings from these studies to develop solutions throughout the county. These projects address several of the top pollution reduction strategies outlined in this Water Quality Improvement Plan. Snohomish County water quality monitoring data can be found on the internet at http://www.data.surfacewater.info.

Recommended Actions: This *Water Quality Implementation Plan* recommends that the county implement low impact development (LID) aggressively in areas of new development and maximize the reduction of stormwater during redevelopment. Projects that maintain, restore or improve natural hydrologic processes should be given significant consideration in the prioritization of capital improvement and public land acquisition projects. Because of the widespread distribution of pollution sources, it is important for SWM to identify pollution sources through both ambient and targeted water quality monitoring. Source identification efforts are needed in both urban and rural areas. The county should continue to work in partnership with the Snohomish Health District in identifying and resolving pollution from on site septic systems.

Solid Waste Management Division
Solid Waste Management programs affect both pet waste and livestock waste management issues. In collaboration with Surface Water Management, Solid Waste Management develops educational materials on how to best manage pet wastes.

Recommended Actions: Where businesses (dog kennels, commercial equestrian facilities, etc…) or small farms are contributing pollution sources outside of the MS4 system, policies, procedures, and education resources should be made available to address this problem.

Snohomish County Planning and Development Services

Snohomish County Planning and Development Services (PDS) develops and administers county regulations for commercial and residential development as well as public projects. The PDS also enforces the Snohomish County Code as it relates to protection of water quality, implements the Critical Areas Ordinance and other development regulations, and works closely with the agricultural community through its agricultural liaison and the Agricultural Advisory Board.

The activities of the PDS greatly affect the generation and treatment of stormwater prompting them to research stormwater BMPs and provide educational outreach to contractors on proper BMP use. Along with other parts of Snohomish County Government, the PDS is promoting Low Impact Development (LID) principles. The county has recently helped sponsor the Sustainable Development Task Force, which is a public/private partnership dedicated to the adoption of strategies that protect the environment by promoting the wise use of building materials, energy efficiency, and the reduction or elimination of stormwater. An experimental LID ordinance was written in 2001 and county staff is now updating that ordinance.

When technical assistance is inappropriate or ineffective, Code Enforcement is an essential follow up activity to remove known pollution sources and also a valuable deterrent to potential violators. Due to the temporal nature of many water pollution problems, Code Enforcement staff should work to ensure that referrals from Surface Water Management staff are addressed promptly. The number of annual referrals for enforcement and the actions taken on those referrals should be tracked annually. Water quality ordinances should be reviewed and revised as needed to allow field staff to quickly identify and take action on obvious water quality problems without the need for providing water quality data.

Recommended Actions: This *Water Quality Implementation Plan* strongly recommends that Snohomish County develop and implement a county-wide phosphorus reduction program in the Cottage Lake Watershed that provides treatment equivalent to Volume V, Section 3.3 of the 2005 Ecology Western Washington Stormwater Manual. The county should continue to investigate and require new technologies for phosphorus removal as they become available and are both reasonable and achievable to implement. Ecology recommends that the county review and implement all of the recommended actions in the subsection Municipal Stormwater Permits discussed earlier in this plan.

Pre-application meetings held as part of the PDS grading, clearing, and land use permitting processes also provide an excellent opportunity to contribute to the goals of this *Water Quality Implementation plan*. Ecology recommends that PDS staff discuss the need for controlling phosphorus from construction sites with project proponents and explain the additional actions they can take as outlined under the subsection Construction Stormwater Permits discussed earlier in this plan.

Snohomish County Parks and Recreation Department

The Snohomish County Parks and Recreation Department oversees over 9,000 acres of public land for recreational use and conservation purposes. The department works with other parts of county government to manage county lands, administers a variety of educational programs, and develops and maintains park facilities.

Recommended Actions: In parks and recreational lands where pets are allowed, pet waste education and collection stations should be installed where there is the potential for them to contribute bacterial pollution to water bodies or stormwater conveyance systems.

Snohomish Conservation District

The Snohomish Conservation District (SCD) is a natural resource agency that provides education and technical assistance to landowners, schools and consultants**.** All landowners within the district boundaries are entitled to free information and technical assistance for water quality protection, wildlife habitat enhancement, farm management plans, soil and slope stability information, native plant products, manure exchange information, volunteer opportunities, stream restoration/enhancement assistance and many other natural resource topics http://www.snohomishcd.org/.

Recommended Actions: SCD should continue to provide guidance and technical assistance to residents with in the watershed. SCD should continue to work with small farms, equestrian facilities, and any landowners that seek support in developing strategies for water quality protection, manure management, farm plan development, and stream rehabilitation.

Washington State Department of Ecology

Ecology has been delegated authority by the EPA to implement many aspects of the federal **Clean Water Act**. This includes the National Pollution Discharge Elimination System (NPDES) permitting and the Total Maximum Daily Load (TMDL) program. The Lake Washington watershed is under the jurisdiction of Ecology's Northwest Regional Office (NWRO). To address the municipal permitting needs of this *Water Quality Implementation Plan*, the NWRO has one municipal stormwater engineer and one municipal stormwater specialist who provide technical assistance and auditing activities for the Phase I and Phase II municipal stormwater permits across the region. An additional municipal permitting staff member will be added to NWRO in mid-2006. Ecology's headquarters also has several staff that help identify and distribute education and outreach materials to stormwater permit holders.

Ecology's NWRO also has a team of six inspectors that oversee compliance with stormwater permits issued to the Washington State Department of Transportation (WSDOT) and nonpublic entities. When technical assistance is not effective or is inappropriate, the NWRO also has two staff responsible for preparing enforcement actions for this team to ensure compliance with NPDES permits.

Ecology has a lake specialist assigned to the implementation of the Cottage Lake TMDL that will assist all parties in coordinating TMDL-related activities. Activities include, but are not limited to informing organizations and agencies about funding opportunities, consulting on proposed implementation projects, and point of contact for information about Cottage Lake and its watershed. NWRO recently hired a water quality monitoring specialist who is available to

provide assistance in the development of ambient monitoring and source identification monitoring projects. Ecology's Environmental Assessment Program will assist in effectiveness monitoring approximately five years following TMDL approval.

Ecology also helps local governments with funding for water quality facilities and activities through the Centennial Clean Water Fund, 319 Fund and State Revolving Loan Fund. The full range of Ecology funding opportunities is discussed under the section "Funding Opportunities." Ecology's Grant Specialists assist local government in the development of stream restoration and water quality improvement projects. Ecology is providing grant funding for King County's Cottage Lake Restoration Project, which is expected to improve water quality in Cottage Lake.

Ecology will be responsible for organizing meetings of the Cottage Lake Steering Committee no less than annually and will lead additional meetings as requested by the Committee.

Recommended Actions: Ecology should continue providing the current level of support for implementing this plan and the municipal stormwater permit. Additional resources are needed to help address nonpoint pollution violations through field inspections.

It is essential to the success of this TMDL that Ecology continue to coordinate TMDL activities within the Cottage Lake Watershed and continue to provide grant funding opportunities to assist in funding TMDL activities.

Monitoring Strategy

Monitoring of surface waters and identification of potential pollution sources will be instrumental to the success of this TMDL. Monitoring is needed during all phases of the TMDL to identify polluted areas, contributing sources, and to verify that corrective actions have been, and remain effective in protecting local waters. Two types of water quality monitoring are needed to implement the Cottage Lake water quality implementation: pollution source detection monitoring and effectiveness monitoring.

Pollution Source Detection Monitoring

Source detection monitoring is used to pinpoint location and relative severity of suspected pollution sources. It allows local government and private groups to focus BMP implementation resources where they are needed most. Source detection monitoring is used when pollution sources are not obvious and additional data is needed to track down the unknown or suspected causes. Events that typically trigger the need for targeted monitoring include:

- When ambient water quality monitoring has identified high phosphorus levels on either a consistent or a sporadic basis.
- Where potential sources of phosphorus are identified and need to be verified. Examples of potential problem areas include areas where soil erosion is occurring, poorly managed animal confinement/recreation areas, failing onsite septic systems, or illicit discharges.

When high phosphorus levels are observed, additional sampling can help to track the source down to a discrete geographic area (Figure 12). Ecology and/or local government will review the data and determine how to proceed to control the source(s). This plan supports funding for targeted monitoring programs to identify pollutant sources and develop programs to reduce or eliminate those sources.

TMDL Effectiveness monitoring

TMDL Effectiveness monitoring tells us whether or not phosphorus levels in Cottage Lake are decreasing. This can be accomplished in two ways: 1) by directly measuring the reduction of pollutants from individual pollution sources or 2) by indirectly measuring the success of this plan by monitoring water quality in Cottage Lake and its tributaries.

Ecology will conduct effectiveness monitoring to determine whether this *Water Quality Implementation Plan* is working. This *Water Quality Implementation Plan* recommends that Ecology use option two above. This plan also recommends that NPDES permit holders conduct effectiveness monitoring using one of these options as well. This plan supports funding for ambient monitoring programs conducted by local government and other groups and agencies in order to determine water quality improvement trends.

Ecology Monitoring: The timing of Ecology's monitoring will depend on the timing of BMPs and the period after which positive results should be identifiable, and the availability of

resources. Ecology hopes to accomplish this approximately once every five years. Effectiveness monitoring priorities will be selected by each regional office and verified through the annual

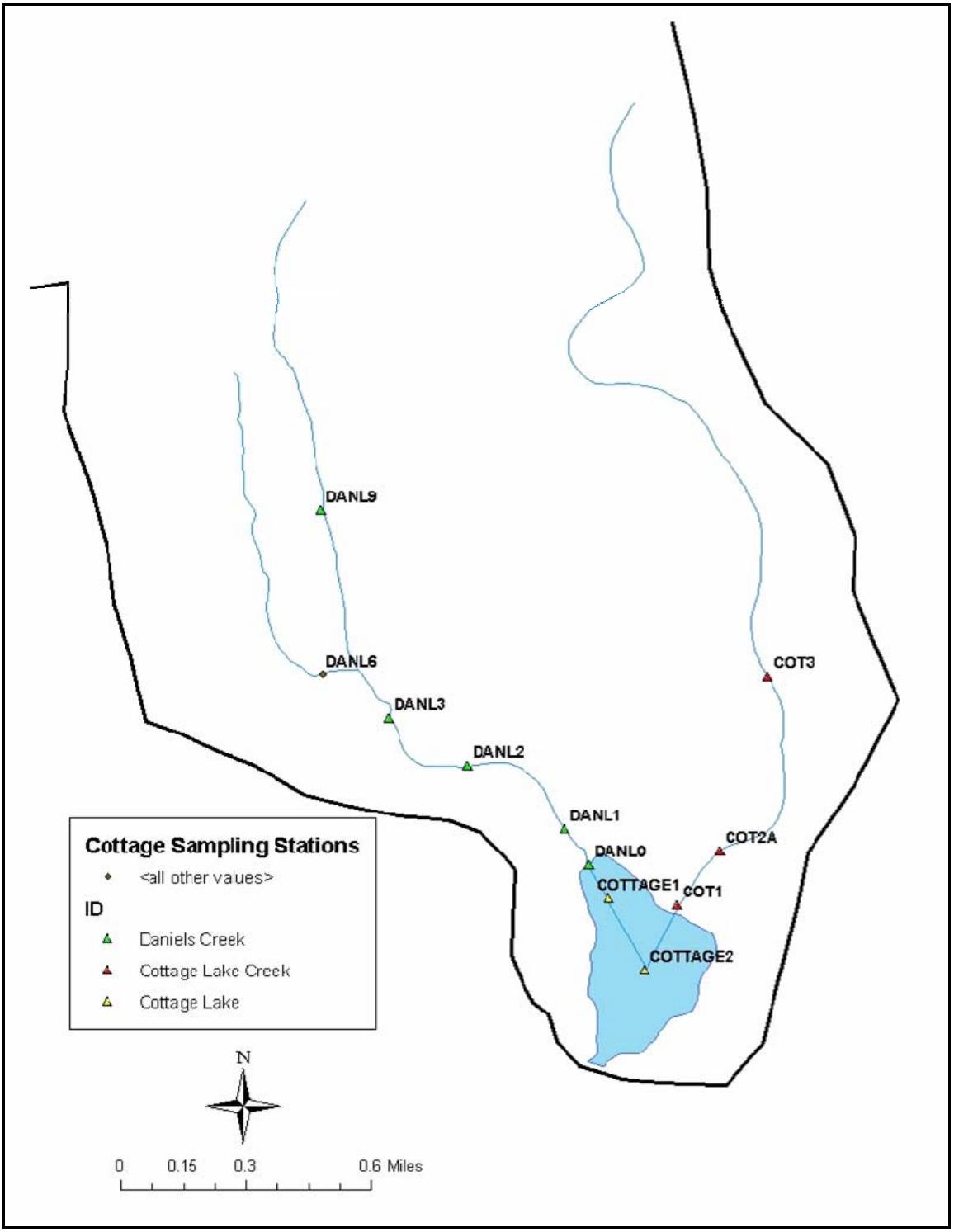

Figure 12. Future water quality monitoring stations.* As part of its Cottage Lake phosphorus reduction project, King County will be monitoring phosphorus levels at the 12 stations above.

* Figure provided by King County Lake Stewardship Program.

scoping process. Ecology will use all available sources of data when effectiveness monitoring is initiated.

In order to be thorough in accomplishing this task, monitoring personnel in Ecology's Environmental Assessment Program (EAP) will follow a review sequence. For this *Water Quality Implementation Plan*, the EAP will contact the regional office TMDL coordinator to determine the status of the TMDL implementation plan and what ongoing monitoring has been initiated as part of implementation activities. On completion of these steps, an examination of the resulting data will be made and a water quality status determination will be announced for the water body in an advisory memorandum followed by a technical report.

NPDES Monitoring: This *Water Quality Implementation Plan* recommends stormwater permit holders monitor and report phosphorus levels in their NPDES discharges. Construction stormwater permit holders are asked to monitor their discharges weekly during wet weather periods. Phase I permit holders are asked to prioritize their ORIs in TMDL areas and to look for phosphorus sources in their screening analyses. They are also encouraged to track the success of other permit-related activities that will contribute to the success of this *Water Quality Implementation Plan*.

Current monitoring activities

A significant portion of King County's *Cottage Lake Phosphorus Reduction Plan* includes water quality monitoring and assessment. The Lake Stewardship Program will perform regularly-schedule monitoring of Cottage Lake and it inlet streams, Daniels Creek and Cottage Lake Creek. Monitoring of Cottage Lake's inlet streams will be used to identify sources of phosphorus loading to Cottage Lake and its inlet streams (Figure 12). Bacterial levels will also be monitored to determine if this particular pollutant is a contributing factor to Cottage Lake and its inlet streams. Assessment of restoration projects will be performed to determine the effects of implementation projects on Cottage Lake and water quality of the inlet streams.

Cottage Lake: Cottage Lake will be sampled once per month for the following parameters: secchi depth, temperature, dissolved oxygen, pH, conductivity, orthophosphate, total nitrogen, total phosphorus, nitrate, ammonia, total suspended solids, fecal coliform, chlorophyll *a*, and phytoplankton

Daniels and Cottage Lake Creek: Daniels and Cottage Lake Creeks will be sampled once per month for the following parameters: temperature, dissolved oxygen, flow, pH, conductivity, orthophosphate, total phosphorus, total suspended solids, and fecal coliform.

Storm Samples: Three storm events will be sampled once per year for total suspended solids, total phosphorus, orthophosphate, and fecal coliform.

Adaptive Management

Adaptive Management is the process by which strategies can be changed if it has been determined that the implementation approach currently in place is not being implemented or water quality goals set forth in the *Water Quality Implementation Plan* are not being met. The *Water Quality Implementation Plan's* first five years will rely on the successful implementation of BMPs, monitoring, grant-funded projects, and through the issuance of the Phase I and Phase II Municipal Stormwater NPDES and State Waste Discharge General Permits and the Construction Stormwater NPDES and State Waste Discharge General permit.

As the permitting programs are put into place and BMPs and other implementation activities are completed, evaluation of their success will be assessed by way of effectiveness monitoring. If new sources of phosphorus loading are identified, they will be corrected through the proper Permitted entities. Ecology will encourage and work closely with local government entities to help resolve these issues as they arise.

Funding sources

Centennial Clean Water Fund (CCWF)

A 1986 state statute created the Water Quality Account, which includes the Centennial Clean Water Fund (CCWF). Ecology offers CCWF grants and loans to local governments, tribes, and other public entities for water pollution control projects. During the FY 2004 funding cycle, Ecology is proposing to award $11.1 million from the CCWF. The CCWF is currently helping fund the Upper Union River Restoration Project and the Lower Union River Restoration Study. These important projects are identifying sources of contamination, recommending and, in some cases, remediating pollution sources. The application process is the same for CCWF, 319 Nonpoint Source Fund, and the state Water Pollution Control Revolving Fund.

Section 319 Nonpoint Source Fund

The 319 Fund provides grants to local governments, tribes, state agencies, and nonprofit organizations to address nonpoint source pollution and to improve and protect water quality. Nonpoint source pollution includes many diffuse sources of pollution, such as stormwater runoff from urban development, agricultural and timber practices, failing septic systems, pet waste, gardening, and other activities. Non-governmental organizations can apply to Ecology for funding through a 319 grant to provide additional implementation assistance.

State Water Pollution Control Revolving Fund

Ecology also administers the Washington State Water Pollution Control Revolving Fund. This program uses federal funding from U.S. Environmental Protection Agency and monies appropriated from the state's Water Quality Account to provide low-interest loans to local governments, tribes, and other public entities. The loans are primarily for upgrading or expanding water pollution control facilities such as public sewage and stormwater plants, and for activities to address estuary management and nonpoint source water quality problems.

Coastal Zone Protection Fund

Since July 1998, water quality penalties issued under Chapter 90.48 RCW have been deposited into a sub-account of the Coastal Protection Fund. A portion of this fund is made available to regional Ecology offices to support on-the-ground projects to perform environmental restoration and enhancement. Local governments, tribes, and state agencies must propose projects through Ecology staff. Stakeholders with projects that will reduce bacterial or nutrient pollution are encouraged to contact their local TMDL lead to determine if their project proposal is a good candidate for Coastal Zone Protection funding.

Salmon Recovery Funding Board (SRFB)

The Salmon Recovery Funding Board (SRFB) provides grants to local governments, tribes, nonprofit organizations, and state agencies for salmon habitat restoration, land acquisition and habitat assessments. Funded projects and programs must produce sustainable and measurable benefits for fish and fish habitat. Most projects designed to improve salmon habitat also provide water quality benefits. As of October 2002, the SRFB has provided grants for 517 projects statewide with an accumulated value of $96.4 million.

The Public Involvement and Education (PIE) Program

The PIE Program supports projects that educate and involve citizens in protecting water quality and biological resources. The PIE Program is administered by the Puget Sound Action Team and assists citizens, schools, businesses, non-profits, local and tribal governments to:

- Create solutions to local pollution problems,
- Protect, preserve and restore habitat,
- Motivate people to be environmental stewards, and
- Collaborate with others for lasting results.

Since 1987, the Legislature has allocated $6 million for nearly 400 PIE projects that have advanced environmental community-based education in the Puget Sound area. The PIE Program uses personal service contracts, managed by the Puget Sound Action Team, to obtain the services of individuals and organizations to educate and involve Puget Sound residents in water quality projects. Action Team staff solicit and select project proposals for funding through the PIE program, and provide guidance and technical assistance on fulfilling the state contracts through the 2001 - 2003 Puget Sound Water Quality Work Plan.

Measuring progress toward goals

Progress of the Cottage Lake Phosphorus Implementation Plan will be measured by 1) assessing the implementation projects completed and 2) direct measurement of water quality. The primary goal in accomplishing theses strategies will be to meet the State's water quality criteria for lake characteristic use. Implementation projects currently identified in the plan are education and outreach, restoration, monitoring, and assessment. Ecology will track implementation projects annually and review construction and municipal permit coverages with the aid of Ecology inspectors.

The goals and targets set forth in the Cottage Lake Total Phosphorus TMDL Submittal Report anticipate that Daniels and Cottage Lake Creeks will meet the TMDL target of 20 ug/L by 2014. With reduction of external phosphorus loading to Cottage Lake over the next decade, the lake should achieve TMDL goals by 2024. If recommendations set forth in the Cottage Lake Implementation Plan are implemented, the goals of the TMDL should be met.

Reasonable assurance

When developing a TMDL, pollutant sources (both internal and external) are taken in account when establishing a target total phosphorus concentration. Reasonable assurances are developed to ensure that all implementation activities discussed in both the Cottage Lake *Total Phosphorus Total Maximum Daily Load Analysis Submittal Report* and *Cottage Lake Total Phosphorus Total Maximum Daily Load Water Quality Implementation Plan* are carried out. Education, outreach, habitat restoration, water quality monitoring, and the implementation of BMPs will be the primary tools used to ensure that the goals of the plan are met.

King County Lake Stewardship Program has received Centennial Grant Funding from Ecology to help fund water clean up activities. The grant will help fund initial implementation activities in the Cottage Lake watershed. The project strives to get watershed residents involved through education and outreach which should result in changes of behavior and attitudes about water quality. If the project is successfully implemented, it may result in a significant reduction in total phosphorus loading to Cottage Lake and its tributaries.

Should current activities be deemed to be ineffective at reducing the amount phosphorus loading to Cottage Lake, Ecology will review the implementation activities and total phosphorus target concentrations, and develop new actions to achieve the TMDL target of 20 ug/L. Ecology may also initiate enforcement, where appropriate.

Enforcement

The Water Pollution Control Act (chapter 90.48 RCW) provides broad authority to issue permits and regulations, and to prohibit illegal discharges to surface water. It designates Ecology as the state water pollution control agency for all the purposes of the federal Clean Water Act. The act openly declares that it is the policy of the state to maintain the highest possible standards to ensure the purity of all waters of the state and to require the use of all known, available, and reasonable means to prevent and control water pollution. The act defines waters of the state and

pollution and authorizes the Department of Ecology to control and prevent pollution, to make and enforce rules, including water quality standards.

Local governments are also expected to continue exercising their authority to enforce their ordinances. Ecology will also encourage local government to enforce local ordinances pertaining to stormwater discharge or water quality where in effect and applicable.

Table 4. TMDL implementation tracking table. Ecology will use the table below to track some of the major activities expected to reduce and control phosphorus discharges to Cottage Lake. Ecology encourages that all the recommended activities in this plan be implemented.

Entity	Action	2005	2006	2007	2008
King County	Conduct septic system dye test with lake front homeowners.			X	
	Conduct 3 BMP workshops to Cottage Lake watershed residents.	X	X	X	
	Organize a community shoreline Plant work parties.		X	X	X
	Report number of implementation strategies installed. Conduct water quality monitoring and review data with the Cottage Lake steering committee and others.	X	X	X	X
Snohomish County	Assist Crystal Lake residents with water quality monitoring.		X		
	Continue funding the South County Basin Watershed Steward and can provide technical assistance to landowners.		X		
King Conservation District	Provide technical assistance to landowners and local residents for various natural resource issues.	X	X	X	X
Woodinville Water and Sewer District	Present education and outreach workshops to watershed residents as well as classroom education to grade school children. All educational formats have been developed specific to the region and are free of charge.	X	X	X	X
Friends of Cottage Lake	Inform other lake homeowners about clean up activities occurring with in the lake and watershed.	X	X	X	X
Upper Bear Creek Community Council	Continue Liaison duties between King County and Upper Bear Creek Community members.	X	X	X	X
Phase I Municipal Stormwater Permit Issuance	To issued by the Department of Ecology.		X		

References

B. Blossey. Department of Natural Resources.1997. Cornell University, Ithaca. Photos of noxious weeds.

Carlson, R.E. 1977.Limnology and Oceanography. "A Trophic State Index for Lakes." Volume 23, Chapter 2. pp 361-69.

Cottage Lake Steering Committee. 2004. Personal Communication with committee members.

Washington Department of Ecology. 2005. Construction Stormwater General Permit.

Washington Department of Ecology. 2006. Phase 1 Municipal Stormwater Permit.

King County Department of Construction and Facilities Management Division of Capitol Planning and Development. 2001. Cold Creek Natural Area: Mary Cash, Cold Creek, Bassett Pond Site Management Plan.

King County Department of Natural Resources and Parks. 2005. Surface Water Design Manual.

King County Lake Stewardship Program. 2005. Cottage Lake Phosphorus Reduction Centennial Clean Water Fund Grant Agreement Between the State of Washington Department of Ecology and King County Natural Resources and Parks.

King County Surface Water Management et al. 1996. Cottage Lake Management Plan.

Minnesota Department of Agriculture et al. August 2004. Phosphorus in Lawns, Landscapes, and Lakes- a guide for understanding phosphorus as a plant nutrient and potential water pollutant.

Murphy, Sheila et. al. 2002. General Information on Phosphorus. An educational guide for citizens. Copyright: Boulder Area Sustainability Information Network (BASIN).

Pennsylvania Association of Conservation Districts. 2004. *Lake Notes*: How to Create Effective Buffer Strips. Lake Notes is a series of publications produced by the Pennsylvania Department of Environmental Protection, Bureau of Watershed Conservation and the US Environmental Protection Agency, Section 319 program.

Whiley, T. 2004. Washington State Department of Ecology, Cottage Lake Total Maximum Daily Load Analysis Submittal Report. Publication # 03-10-085.

Appendix A. Acronyms and Glossary

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State periodically to prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

Best management practices (BMPs): Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

Clean Water Act (CWA): Federal Act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the CWA establishes the TMDL program.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

Effective shade: The fraction of incoming solar shortwave radiation that is blocked from reaching the surface of a stream or other defined area.

Enterococci: A subgroup of the fecal streptococci that includes S. *faecalis*, *S. faecium* , *S. gallinarum* and *S. avium*. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

Epilimnion: Upper layer of water in a lake.

Eutrophic: The process whereby lakes receive excess nutrients that stimulate excessive plant growth.

Eutrophication: The aging process of lakes.

Existing uses: Those uses actually attained in fresh and marine waters on or after November 28, 1975, whether or not they are designated uses. Introduced species that are not native to Washington, and put-and-take fisheries comprised of nonself-replicating introduced native species, do not need to receive full support as an existing use.

External loading: The introduction of total phosphorus and other pollutants from sources with in the watershed.

Extraordinary primary contact: Waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas.

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the

product of acid or gas from lactose in a suitable culture medium within twenty-four hours at 44.5 plus or minus 0.2 degrees Celsius. FC are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100mL).

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from ten to 10,000 fold over a given period. The calculation is performed by either: 1) taking of the nth root of a product of n factors, or 2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Hypolimnion: The cold lower layer of water in a lake.

Internal loading: When phosphorus that is released from the lake bottom sediments is then circulated up into the water column.

Load allocation (LA): The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading capacity: The greatest amount of a substance that a water body can receive and still meet water quality standards.

Mesotrophic: Lakes containing a moderate amount nutrient.

Metalimnion: The layer in a lake where temperature changes rapidly with depth.

Municipal separate storm sewer systems (MS4): A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): (i) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body having jurisdiction over disposal of wastes, storm water, or other wastes and (ii) designed or used for collecting or conveying stormwater; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

National pollutant discharge elimination system (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the National Pollutant

Discharge Elimination System Program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Oligotrophic: A lake that is nutrient poor, and has very little aquatic plant and animal life.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

Phase I stormwater permit: The first phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to medium and large municipal separate storm sewer systems (MS4s) and construction sites of five or more acres.

Phase II stormwater permit: The second phase of stormwater regulation required under the Federal Clean Water Act. The permit is issued to smaller municipal separate storm sewer systems (MS4s) and construction sites over one acre.

Point source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution: Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish, or other aquatic life.

Primary contact recreation: Activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands and all other surface waters and water courses within the jurisdiction of the state of Washington.

Target concentration: Provides the foundation for which the load capacity and wasteload allocation (pollutant source) are determined.

Total maximum daily load (TMDL): A distribution of a substance in a water body designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: 1) individual wasteload allocations (WLAs) for point sources, 2) the load allocations

(LAs) for nonpoint sources, 3) the contribution of natural sources, and 4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Total phosphorus: The measure of soluble and non-soluble organic phosphorus.

Trophic state: The amount of biological production of both plant and animal life, that occurs in a lake.

Wasteload allocation (WLA): The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of **point source** pollution.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Appendix B: Criteria for lakes

The Department of Ecology, by process of adoption of State water quality standards, has re-defined criteria for fresh waters and lake class. Prior to development, Ecology classified water bodies in A, AA, B, and C classes. Classification is now defined by actual use (i.e., swimming, water supply, and fish habitat.) The new classification has been in effect since August 1, 2003, and only applies to freshwater.

For more information on Washington State's water quality standards, refer to http://www.ecy.wa.gov/programs/wq/swqs/index.html

Protection of Characteristic uses [WAC 173-201A-030(5)] Lake Class Characteristic uses shall include, but not be limited to, the following:

1) Water supply (domestic, industrial, agricultural).
2) Stock watering.
3) *Fish and shellfish:
   Salmonid migration, rearing, spawning, and harvesting.
   Other fish migration, rearing, spawning, and harvesting.
   Clam and mussel rearing, spawning, and harvesting.
   Crayfish rearing, spawning, and harvesting.
4) *Wildlife habitat.
5) *Recreation (primary contact recreation, sport fishing, boating, and esthetic enjoyment).
6) Commerce and navigation.

Framework for establishing TP criteria for lakes

Trophic State	Ambient TP Range (ug/L)	TP Criteria
Ultra-Oligotrophic	0 – 4	4 or less
Oligotrophic	>4 – 10	10 or less
Lower Mesotrophic	>10 – 20	20 or less
Mesotrophic – Eutrophic	>20	Lake Specific Study

The Tropic State Index (Carlson 1977) is used to determine the trophic status of a lake, and its lake overall health. Total phosphorus, secchi depth, and chlorophyll *a* are the three parameters measured.

The range in TSI parameters as they relate to lake trophic status.

Trophic State	Secchi Depth (m)	Chl(a) (ug/L)	TP (ug/L)	TSI
Oligotrophic	> 4	< 3	< 14	< 40
Mesotrophic	2 – 4	3 – 9	14 – 25	40 – 50
Eutrophic	< 2	> 9	> 25	> 50

*Currently Cottage Lake's trophic state is **mesotrophic-eutrophic.**

Appendix C: Wasteload allocation for Cottage Lake

The Cottage Lake TMDL Submittal Report (Whiley 2004) examined available information on lake phosphorus levels, current and future land uses, and known sources of phosphorus loading. This information was used to model the phosphorus dynamics in Cottage Lake and quantify the allowable levels of phosphorus discharged to the lake. During the preparation of this implementation plan, new information was discovered, revealing the presence of a direct stormwater discharge to Cottage Lake. For that reason, Ecology has decided to redistribute the available phosphorus loading capacity for the lake to allow a wasteload allocation (WLA) for stormwater. This appendix describes the rationale and procedure for redistributing a portion of the load allocation to the category of wasteload allocation, thus allowing for the legal discharge of phosphorus in stormwater from a previously unknown lake outfall.

Overview of the TMDL allocation process

How do you measure a TMDL? The TMDL is the maximum amount of a pollutant that a water body can accept and still meet water quality standards. In common usage, the term TMDL is also used to describe the entire process for cleaning up an impaired water body. For our purposes in this section it refers to a discrete amount of pollution, or load that is divided into three components; the **wasteload allocation**, the **load allocation**, and the **margin of safety** (Figure 1A). These three components make up the **loading capacity**.

Establishing the Loading Capacity

1) **Wasteload Allocation (WLA)**: This represents the contribution of discrete "point" sources of pollutants (e.g., municipal, industrial, and construction stormwater discharges);

2) **Load Allocation (LA)**: This represents "nonpoint" sources of a pollutant, (natural sources, most agricultural activities, and other sources that are not regulated by an Ecology permit); and

3) **Margin of Safety (MOS):** This allows for uncertainty in the estimation of, and ability to achieve, the previous two allocations.

Thus, the TMDL equation is as follows:

TMDL = WLA + LA + MOS.

The sum of these three components is also called the **Loading Capacity**.

Figure 1A. Elements of the TMDL Loading Capacity.

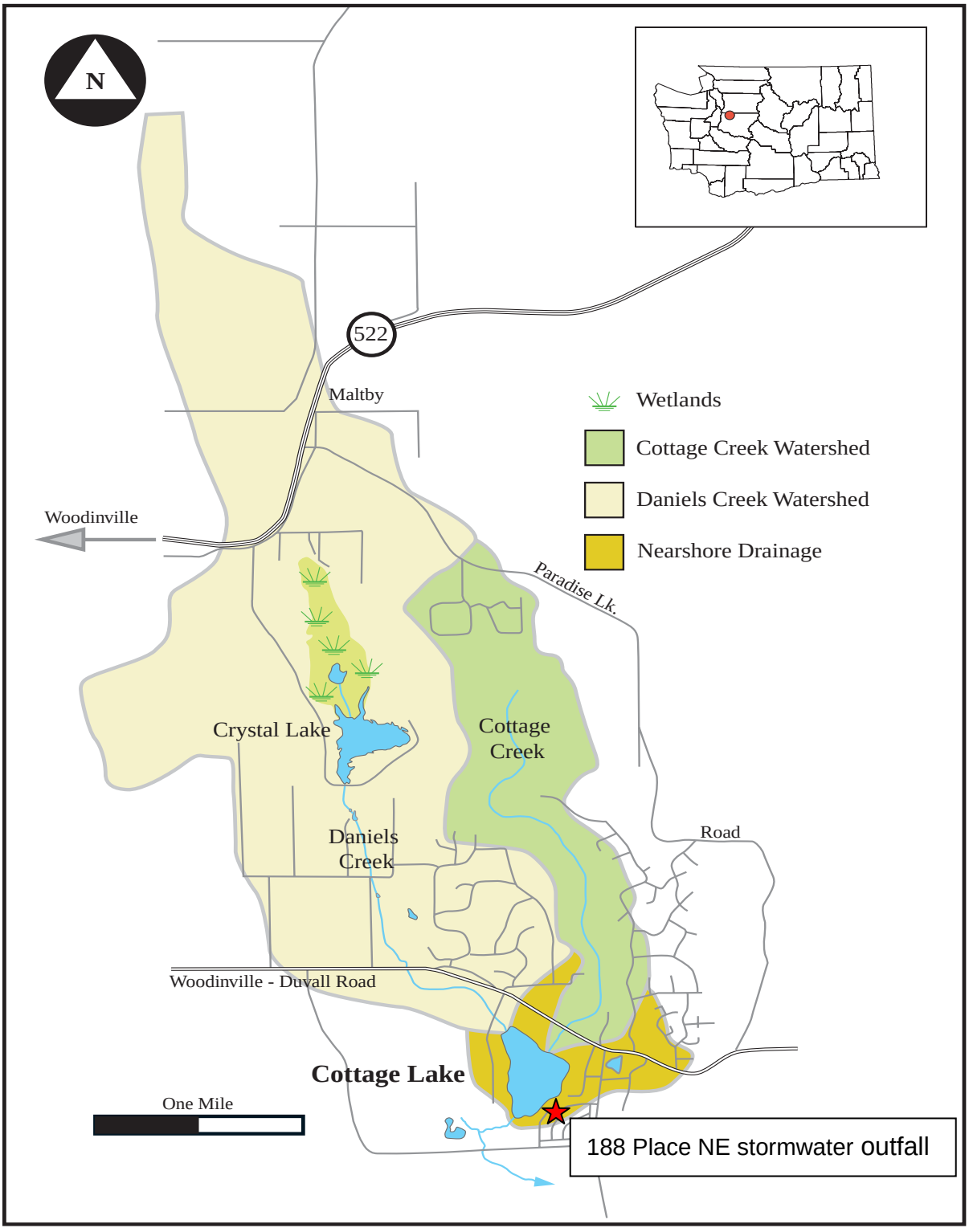

Figure 2A. The Cottage Lake Watershed includes three subwatersheds: Daniels Creek, Cottage Lake Creek, and the nearshore drainage area. This TMDL amendment pertains to stormwater phosphorus loading from a portion of the nearshore drainage area. The location of the 188 Place NE outfall is indicated by the red star.

What is the goal of the TMDL? The goal of the Cottage Lake TMDL is to keep phosphorus loadings to the lake at or below the loading capacity. Lowering the phosphorus levels will reduce algal blooms and improve lake water quality for a variety of uses. We will know when we have reached this level of phosphorus reduction when lake epilimnion concentrations are at or less than 20 ug/L during June through August.

How does this amendment relate to the original TMDL? The Cottage Lake TMDL Submittal Report examined monthly phosphorus levels and set a loading capacity for June through August, when plant uptake of phosphorus and recreational usage are typically highest. Although the critical period occurs during the summer months, loading during other months must also be reduced. This amendment does not change any of the technical analysis on overall phosphorus loadings to the lake.

Amending Cottage Lake phosphorus allocations

Why is Ecology changing the load and wasteload allocations? When preparing the original TMDL, Ecology performed field assessments and worked with local governments to identify pipes that discharged to Cottage Lake. No direct discharges were observed. During preparation of this implementation plan, Ecology discovered a stormwater outfall on the southeast shore of the lake adjacent to 188 Place NE. For that reason, Ecology has decided to modify the Cottage Lake TMDL to redistribute a portion of the existing load allocation to the category of WLA. This modification does not increase the total allowable amount of phosphorus loading to Cottage Lake.

What is the current loading capacity? Ecology set the phosphorus load capacity for the months June through August at 43 kg. All of this capacity was originally allocated to the load allocation, which reflects contributions from **nonpoint** pollution sources. The distribution among the contributing areas of the watershed is shown in Table 1A.

What change is Ecology making in amending the TMDL? Because municipal stormwater discharged directly to the lake is considered a **point source** of pollution, a WLA is needed for the 188 Place NE outfall. This amendment creates a WLA by distributing a portion of the load allocation from the nearshore area (Figure 2A) to the category of WLA. The total allowable amount of phosphorus loading to Cottage Lake from the nearshore area is not changed.

Municipal stormwater is discharged during the winter and the TMDL sets summer limits. Why is a WLA necessary? Ecology examined area rainfall patterns and determined that approximately 10.4% of annual precipitation falls during June through August. Thus, stormwater discharges from municipal storm sewer systems are possible during the critical summer season. In addition, controls on summer stormwater phosphorus are expected to help reduce winter stormwater phosphorus. TMDLs must address loading from point sources covered under National Pollution Discharge Elimination System (NPDES) permits.

Table 1A. Amendment to Cottage Lake phosphorus load and wasteload allocations. The total loading capacity for phosphorus was distributed to nonpoint and point sources and is measured in the lake epilimnion during June through August. A portion of the nearshore loading capacity is amended downward to allow for the 188 Place NE stormwater outfall.

Total Phosphorus Source	Loading Capacity Distribution (kg/June-August)	
	Original TMDL	Amended TMDL
Daniel's Creek subbasin	16	16
Cottage Lake Creek subbasin	4	4
Nearshore surface water runoff	1	0.98
Nearshore groundwater inflow	3	3
Internal recycling	15	15
Wasteload Allocation (King County MS4)	0	0.02
Margin of Safety	4	4
Total	**43**	**43**

How did Ecology compute the new wasteload allocation? Ecology examined local data to characterize the discharge of phosphorus from a suburban area. Using the Simple Method (CWP 2005), an export coefficient of 0.49 kg P/hectare-year (ha-yr) was developed and the annual discharge of total phosphorus was determined to be approximately 0.5 kg/yr as follows:

Drainage Area (1 ha)	x	*Phosphorus Export Loading Coefficient (0.49 kg/ha-yr)*	=	*Annual Loading from the outfall (0.5 kg/yr)*

Because the TMDL sets allocations during the period June-August, the percentage of precipitation falling during the period was used to estimate summer loadings as follows:

Annual loading from the outfall (0.5 kg)	x	*Percentage of rainfall occurring during the summer (0.104 or 10.4%)*	=	*Estimated Summer Loading from 188 PL NE outfall (0.05 kg)*

Finally, the TMDL calls for a 60 percent reduction in stormwater runoff phosphorus levels based upon an analysis of future conditions. Therefore, the final WLA for the 188 Place NE outfall is as follows.

Estimated summer loading from 188 PL NE outfall (0.05 kg)	x	*60% reduction in stormwater phosphorus loads (0.40 or 40%)*	=	*Final WLA for the 188 PL NE outfall (0.02 kg)*

Thus the final WLA for the 188 Place NE outfall is 0.02 kg during the June-August period. Because the total phosphorus loading allowed for nearshore surface water discharges is 1 kg, the new wasteload allocation is about 2% of the current nearshore load allocation (Table 1).

Wasteload allocation for total phosphorus in stormwater at 188 Place NE

(King County MS4) = .02 kg (June – August)

Can this allocation approach be used in other areas of the Cottage Lake watershed to create new wasteload allocations? This allocation approach applies only to the outfall located adjacent to the 188 Place NE catch basin. The development of any future wasteload allocations for the Cottage Lake TMDL must be assessed on a case-by-case basis to evaluate whether more detailed analyses are needed.